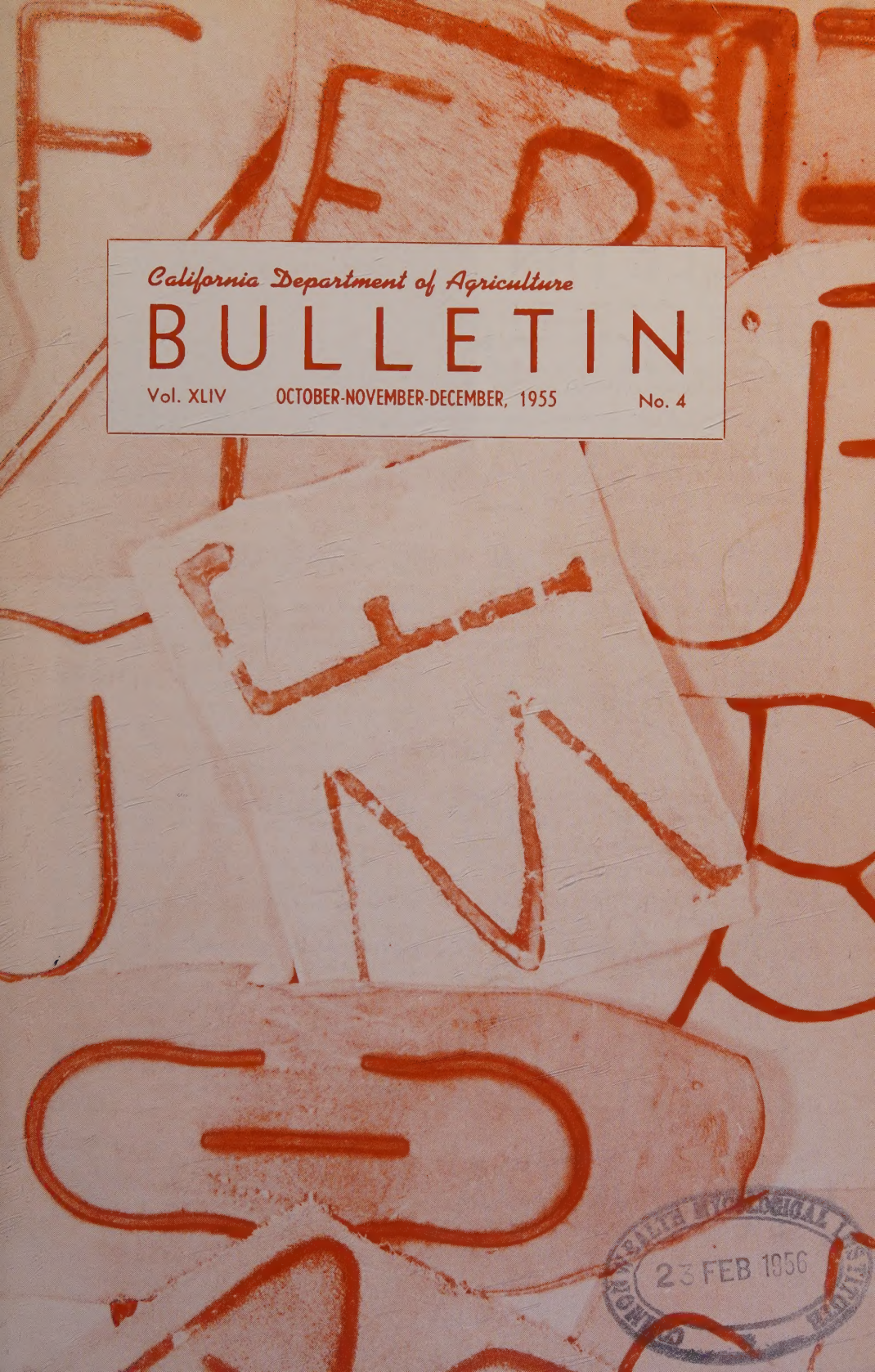

California Department of Agriculture

BULLETIN

Vol. XLIV OCTOBER-NOVEMBER-DECEMBER, 1955 No. 4

23 FEB 1956

STATE OF CALIFORNIA
GOODWIN J. KNIGHT, *Governor*
HAROLD J. POWERS, *Lieutenant Governor*

QUARTERLY

BULLETIN

Volume XLIV Number 4

Official Journal of the Department of Agriculture, State of California

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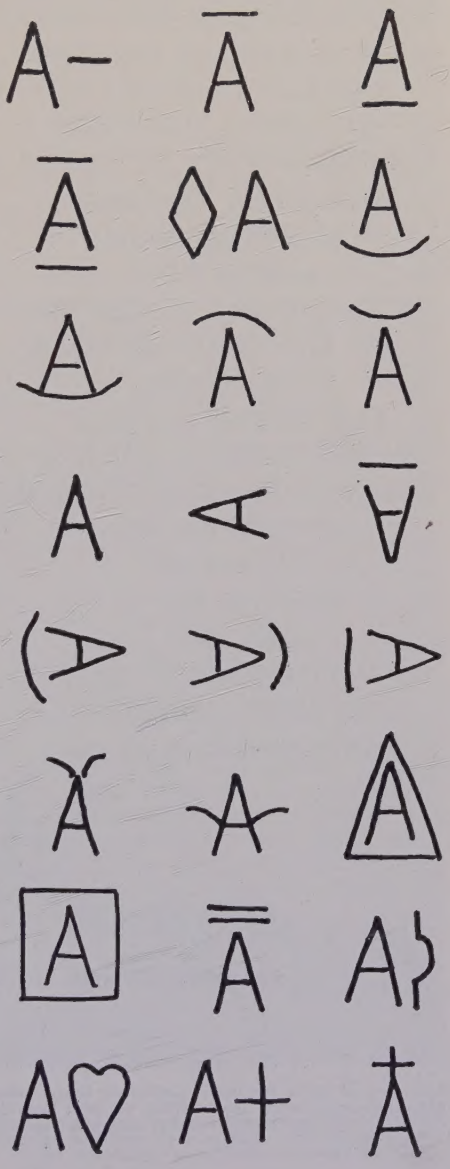
Will You Lose Your Livestock Brand in 1959?

By LOGAN MORTON, *Chief, Bureau of Livestock Identification, California Department of Agriculture*

Owners of livestock brands in California face a problem of which they may not be aware. On the other hand, many of the 28,000 brand holders may be apathetic in the face of new procedures and new laws which seek to redirect the history and traditions of many old brands. There are brand designs in use today in California which were first recorded by Spanish and Mexican officials of the Eighteenth and Nineteenth Centuries. Early recording of these brands with offices of county recorders does not give them priority over similar brands which were recorded at a later date with the State Department of Agriculture.

In 1917, when the hide and brand laws were first made effective, the State was divided into branding districts. Since cattle population was small and the industry still young, it was permissible to record similar brands as long as they were not to be used in adjacent districts. A cattleman in San Diego County may have a brand recorded for his use in San Diego County, but identical to a brand recorded to another cattleman in Modoc County. The danger of mixing animals of these two cattlemen was very remote.

As the industry grew and truck transportation became common, livestock was moved great distances for pasture. This movement increased the problem of livestock with similar brands becoming mixed. Branded animals not only moved to counties where like brands were in use, but in several instances similar brands were found on adjacent ranches. It soon became apparent that some action was needed to prevent unlawful possession of livestock which sometimes results from mixing of herds with similar brands.

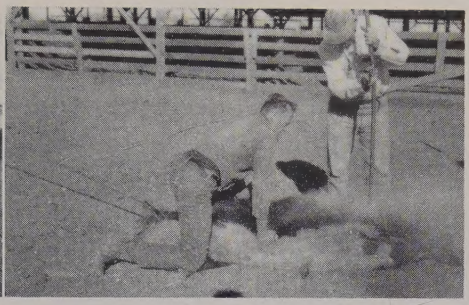


After January 1, 1959, owners of the basic letter "A" brand (or any duplicated brand) must forfeit their design to the holder of the lowest registration number. Their choice of variations for this letter will be limited; variations on the letter "A" design for the left hip position, now registered in California, are shown at right.

CATTLE BRANDS OF CALIFORNIA MISSIONS

NAME	FOUNDED	LOCATION	BRAND	CATTLE
SAN DIEGO DE ALCALA	1769	SAN DIEGO	D	8,000
SAN LUIS REY DE FRANCIA	1798	SAN LUIS REY	3	26,000
SAN JUAN CAPISTRANO	1776	CAPISTRANO	CA	10,000
SAN GABRIEL ARCANGEL	1771	LOS ANGELES	F	20,500
SAN FERNANDO REY DE ESPAÑA	1797	SAN FERNANDO	4	12,500
SAN BUENA VENTURA	1782	VENTURA	AB	17,300
SANTA BARBARA	1786	SANTA BARBARA	B	3,600
SANTA INEZ	1804	SANTA INEZ	SI	7,300
LA PURISMA CONCEPTION	1787	CONCEPTION	9	10,500
SAN LUIS OBISPO DE TOLOSA	1772	SAN LUIS OBISPO	S	8,600
SAN MIGUEL	1797	SAN MIGUEL	3	9,000
SAN ANTONIO DE PADUA	1771	MONTEREY CO.	A	5,000
NUESTRA SENORA DE LA SOLEDAD	1791	SOLEDAD	4	6,600
SAN CARLOS BORROMEO DEL CARMELO	1771	CARMEL	MR	2,050
SAN JUAN BAUTISTA	1797	SAN JUAN	A	11,000
SANTA CRUZ	1791	SANTA CRUZ	A	3,500
SANTA CLARA	1777	SANTA CLARA	SA	9,000
SAN JOSE	1797	MISSION SAN JOSE	J	2,000
SAN FRANCISCO DOLORES	1776	SAN FRANCISCO	F	4,200
SAN RAFAEL ARCHANGEL	1817	SAN RAFAEL	G	1,200
SAN FRANCISCO DE SOLANO	1824	SONOMA	F	2,500

Recording of cattle brands in California began when the Spanish Missions adopted identifications for their extensive cattle herds. The tradition of these beautifully designed brands continues today in California's important cattle industry, and with the work of the Bureau of Livestock Identification.



The two scenes shown here illustrate cattle branding as still practiced today in some areas of California. Although other techniques are now in use, which speed up the branding of large numbers of cattle, the system shown above is workmanlike and dependable.

The California Legislature enacted in 1947 a law prohibiting the issuance of a livestock brand except on a state-wide basis, on and after the effective date of the law. This law further provided that by January 1, 1959, no two similar brands could remain in use in California. The date of January 1, 1959, was set in order to give brand owners a period of time during which they could adjust their brands by adding a character to their irons and yet retain the basic design of the brand for use on a state-wide basis.

Although this law has been in effect for eight years, surprisingly few requests have been received from owners of registered brands to adjust their irons. Adjustment should be made at an early date in order to record a satisfactory brand.

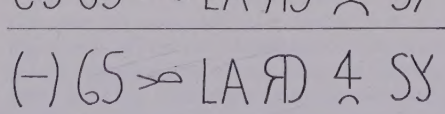
As an example of what may happen by further delay, assume that you own the brand letter "A" on the left hip. There are at present five similar brands recorded for this position. If you inquire about additional characters, you will find there are already registered the variations of the letter "A" as shown in the accompanying illustration. It is then that you suddenly realize there are few characters left which may be added to the letter "A" for the left hip position.

On January 1, 1959, all owners of the "A" brand on the left hip, except the one bearing the lowest registration number, will have to forfeit this brand. Since there are so few choices remaining for the left hip, a brand owner may decide to choose another position for his brand. There are eight legal branding positions in California: the neck, shoulder, ribs and hip on both sides of the animal. But brand owners soon discover that the choice of design is just as limited for the other seven positions.

If brand holders wait until the latter part of 1958 to adjust their design, they may have to record an entirely new iron, for it may be impossible at that late date to find an adjustment which will permit the retention of the basic design. The above example of the variations of the "A" brand design emphasizes the reason for an early adjustment.

In 1954 the California Department of Agriculture issued a regulation which requires the filing of a burned imprint of each branding iron before a new brand may be registered. The regulation also provides that no registered brand may be renewed after 1957, unless a burned imprint of the branding iron has been approved and is on file with the Bureau of Livestock Identification. This regulation was introduced to assure the department that branding irons are made and used in conformity with the recorded design. Typical examples of the difference between the branding irons as made and designs as recorded are well illustrated in the accompanying chart.

These examples reveal the fact that a cattleman may be branding his cattle with a design which has been recorded to some other person, if his iron is not made to conform exactly to his recorded design. The purpose of branding is to indicate ownership. If the iron being used does not conform to the owner's design but conforms to



Shown here are typical examples of the difference between branding irons as made and used (bottom), and the design as officially recorded (top).

Great cattle drives of the nineteenth and early twentieth century have been supplanted by the truck which uses modern, high-speed roads to haul cattle to marketing centers. Shown above is a scene photographed perhaps 50 years ago, during a cattle drive along the Chisholm Trail.

some other person's recorded design, there might be a strong presumption of ownership for the other person. Section 338.1 of the Agricultural Code provides, "It shall be unlawful for any person to use a brand on cattle indicating ownership unless the cattle are owned by him or he has been authorized by the owner of the cattle and the brand is recorded under the owner's name and is on file with the Bureau of Livestock Identification."

It is therefore imperative that users of livestock brands ascertain whether their branding irons conform to the designs recorded for their use. This may be accomplished by filing with the Bureau of Livestock Identification at Sacramento a burned imprint of the branding iron in question. The filing of the imprint will also enable the bureau to inform all brand holders whether or not their iron will have to be adjusted before January 1, 1959. Imprint blotters may be secured from local brand inspectors or county farm advisers. They may also be obtained from the Bureau of Livestock Identification, 1220 N Street, Sacramento.

Act now to save your basic brand design.

Eriophyes insidiosus
Keifer and Wilson, New Species

A NEW SPECIES OF ERIOPHYID MITE RESPONSIBLE FOR THE VECTION OF PEACH MOSAIC VIRUS

By H. H. KEIFER, *California Department of Agriculture*, and
NORTON S. WILSON, *Entomology Research Branch, United States Department of Agriculture*

With the proof that a species of *Eriophyes* is responsible for the natural vection of Peach Mosaic Virus, it becomes necessary to give this mite a name. We, therefore, present the following description:

Eriophyes insidiosus Keifer and Wilson, new species:

Female 160-190μ long, 35-40μ thick, wormlike, color dull yellowish white. Rostrum 20μ long, curved down. Shield 19μ long, 29μ wide; median line complete, reaching almost to rear margin; admedians complete, gradually diverging to the rear but recurving centrad at rear margin of shield; an outwardly diagonal line in front of dorsal tubercle; submedian line complete, variable at rear but usually ending laterad to dorsal tubercle in a dart-shaped mark comprising the diagonal from ahead of dorsal tubercle and another arising from lateral shield granules; lateral shield granules in lines framing central shield area and curving down to rear; dorsal tubercles 13μ apart; dorsal setae 17μ long, projecting up and forward. Forelegs 21μ long, tibia 3μ long, with seta; tarsus 4.5μ long, claw 6μ long, slightly knobbed; featherclaw 4-rayed. Hindlegs 19μ long, tibia 3μ long, tarsus 4.5μ long, claw 7μ long. Anterior coxae contiguous, the coxae lined with microtubercles. Abdomen with 50-55 rings, completely microtuberculate; microtubercles rounded, unpointed, about 7 microtubercles in a 10 micron vertical distance on central part of body. Lateral seta 25μ long, on about ring 7 behind shield; first ventral seta 28μ long, on about ring 19; second ventral 6μ long, on about ring 27; third ventral about 18μ long, on ring 5 from rear. Accessory seta present. Female genitalia 17μ wide, 9μ long, coverflap with about 12 longitudinal furrows; seta 6μ long.

Males present, slightly smaller than females.

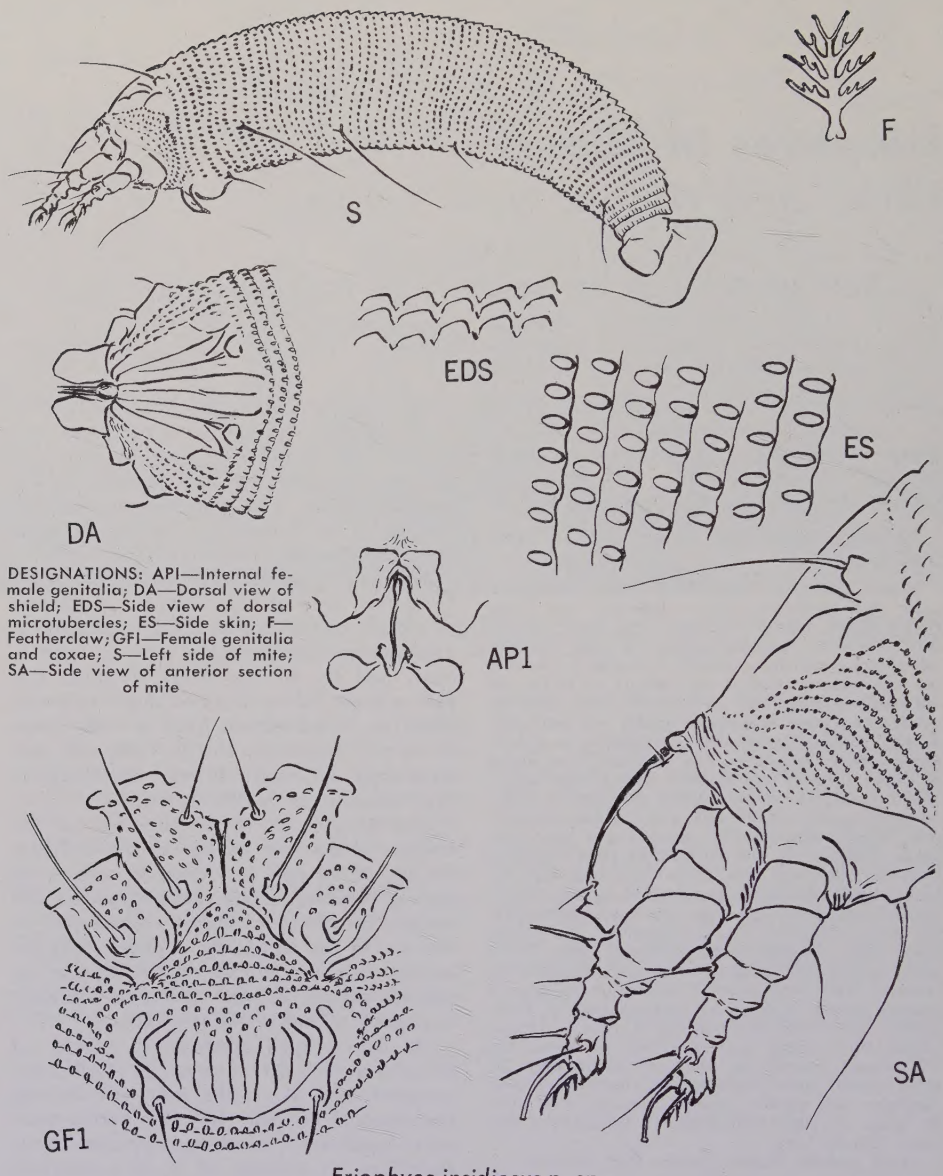
Type locality: Moreno, Riverside County, California. **Collected:** June 21, 1955, by N. S. Wilson. **Host:** *Prunus hortulana* Bailey, hortulana plum (Rosaceae). **Relation to host:** The mites live and breed in the buds. This activity causes no apparent damage. The damage caused by virus carrying is another consideration. **Type material:** A type slide and five paratype slides bear the above data. In addition five paratype slides are of mites from diseased Rio Oso Gem peach, *Prunus persica* S. & Z., collected August 21, 1955, at Moreno by Wilson. This mite was first seen by Wilson in peach buds, but the type material exemplifying the species is from hortulana plum. The type slide and 3 paratype slides are deposited in the United States National Museum collection.

The new mite, as a member of the genus *Eriophyes*, belongs to a complex population of closely related forms. This population is distinguished by having a 4-rayed featherclaw, and by an outwardly diagonal line just in front of each dorsal shield tubercle. Mites so characterized have a wide range on native *Prunus* species in California and apparently on native *Prunus* elsewhere on the continent of North America.

The question as to whether or not the various forms that occur on the different species of *Prunus* are distinct species, or merely varieties of one variable species, will remain for future cultural experiments to answer. In the meantime it seems most expedient to call segments of this mite group distinct species, if some structural character is present to make this possible.

Of the 4-rayed featherclaw species of *Eriophyes* so far named in California, *prunandersoni* K. is the only one bearing the diagonal line and therefore comes nearest to *insidiosus*. However, on *prunandersoni* there are an average of 5 to 6 microtubercles on the rings in the central part of the abdomen in a vertical distance of 10 microns. But on *insidiosus* there are usually 7 and often 8 or 9 microtubercles in this distance. Occasionally the count is 6, but the microtubercles on *insidiosus* average distinctly smaller and closer than on *prunandersoni*. This difference is easily perceived.

We have examined mites from buds and from leaf erinea on various native *Prunus* species in California that occur in Shasta


S
F
EDS
ES
DA
DESIGNATIONS: API—Internal female genitalia; DA—Dorsal view of shield; EDS—Side view of dorsal microtubercles; ES—Side skin; F—Featherclaw; GFI—Female genitalia and coxae; S—Left side of mite; SA—Side view of anterior section of mite
AP1
GF1
SA

Eriophyes insidiosus n. sp.

County, Alpine County, Mono County and San Diego County. These mites have 4-rayed featherclaws and the diagonal line in front of the dorsal tubercle. None of these mites have as small or as close-set microtubercles as *insidiosus*. They are referable to *prunandersoni*.

This leads to the supposition that *insidiosus* may have originated at some point east of California. The fact that both *insidiosus* and peach mosaic occur as far east as Colorado, or farther, supports this idea. The type host of *insidiosus* which is *Prunus hortulana* is native to the Mississippi Valley and should be investigated in that area.

REFERENCE:

N. S. Wilson, L. S. Jones and L. C. Cochran—An Eriophyid Mite Vector of the Peach Mosiac Virus. Plant Disease Reporter. 39 (12): December 15, 1955.

Effects of Residual DDT On Beet Leafhoppers

By HAROLD LeROY WILSON, *Bureau of Entomology, California Department of Agriculture*

DDT has been used in the control of the beet leafhopper, *Circulifer tenellus*, in California for the past 10 years. This has been particularly true with respect to control measures being applied annually along the western side of the San Joaquin Valley. This control is designed to reduce during fall, winter and spring the number of leafhoppers later migrating back into the agricultural area on the floor of the valley. Reduction in numbers lessens the incidence of "curly top" virus transmitted to susceptible crops.

It has been an accepted fact that the residual effect lasted some time beyond the date of spray application. If the actual length of time this DDT remained effective could be worked out, a standard length of time could be set up, which would indicate how often an area requires spraying. This is especially important during spring hatching when some areas must be sprayed early in order to have time enough to treat the entire control area before the early hatching nymphs turn into adults and start migrating. The following is a report covering the results of laboratory and field tests made to determine the residual effect of DDT on the leafhopper, as now used in this control effort.

Material

Spray material which was used was the standard DDT spray formula used on the control project. This formula consists of one pound of technical DDT in two gallons of diesel oil, applied to one acre of ground using a Dodge power wagon equipped with a Buffalo turbine sprayer. This sprayer uses a heavy current of air as a carrier, breaking the spray into a fine fog and covering a 100-foot swathe.

The plant materials used were two kinds of winter and spring annuals, Red stemmed filaree, *Erodium cicutatium* and *Plantago insularis*. These plants were obtained from a hill in the field after spraying. The filaree plants used as a control were secured from a similar hill about one-fourth mile south of the control area.

Method

Spraying of beet leafhoppers, in normal winter operations, is conducted until February 1st. After the applications were made, during normal spray operations, at an area on Dodge Hill west of Coalinga, lumps of soil containing small host plants were removed from the ground and placed in flower pots in an entire piece. These transplanted host plants were held for use and observation at the headquarters grounds in Coalinga. These units of host plants were left in the open where normal sun, air and rainfall could come into contact with them. Chart No. 2 shows the records, collected by the City of Coalinga Fire Station, which show temperature and rainfall during the experimental period.

The leafhoppers were then collected from an area south of Jacalitos Canyon, which had been left unsprayed to provide a population for future marking experiments. These leafhoppers, collected with a standard sweep net, were installed on the field-sprayed vegetation, which had been placed in glass and cloth cages exposed to the prevailing weather.

After the beet leafhoppers had remained on the vegetation from three to six days, they were removed and counted. Condition of the live ones was noted; the dead ones were removed from the plants and soil. Listed with the dead ones were some which were lost. It was observed during the process of removal that many leafhoppers were hidden in cracks and crevices in the soil, which would account for the absence of dead beet leafhoppers around sprayed host plants in the field. Very few leafhoppers were found after spraying, even though high numbers were present in the plants

	2/2/55	2/4/55	2/4/55	2/8/55	2/8/55	2/14/55	2/15/55	2/21/55	2/21/55	2/24/55	2/28/55	3/7/55
1. *Plantago insularis* sprayed 2/1/55 Dodge Hill, Coalinga	On 10 BLH	Off 4 dead 6 lost	On 10 BLH	Off 9 dead 1 alive	On 11 BLH	Off 7 dead 4 lost	On 10 BLH	Off 10 dead	On 10 BLH	Off 9 dead 1 alive		
2. *Erodium cicutarium* sprayed 2/1/55 Dodge Hill, Coalinga	On 10 BLH	Off 7 dead 1 lost 2 dying	On 11 BLH	Off 5 dead 6 alive (sick)	On 10 BLH	Off 4 dead 6 alive (Active)	On 10 BLH	Off 7 dead 2 alive 1 lost		On 12 BLH	Off 6 dead 6 alive	
3. *Erodium cicutarium* unsprayed ¼ mile S. of Dodge Hill, Coalinga	On 5 BLH	5 alive		5 alive		5 alive	5 alive	1 dead 4 alive				3 dead 2 alive
4. *Erodium cicutarium* sprayed 2/1/55 Dodge Hill, Coalinga			On 10 BLH	Off 6 dead 2 alive 2 lost	On 10 BLH	Off 6 dead 1 alive 3 lost	On 11 BLH	Off 8 dead 3 alive	On 8 BLH	Off 4 dead 4 alive		
5. *Plantago insularis* sprayed 2/1/55 Dodge Hill, Coalinga			On 12 BLH	Off 4 dead 1 alive 7 lost	On 8 BLH	Off 8 dead	On 12 BLH	Off 9 dead 3 lost		On 13 BLH	Off 12 dead 1 alive	

CHART No. 1

before application of the spray. All leafhoppers listed as lost in the final recording were considered dead, a more probable conclusion than escape. Although the plant debris and small stones complicated removal of dead leafhoppers, they were left in the cage since they were probably covered with DDT.

Upon removing one group of leafhoppers from a cage of sprayed *Erodium* or *Plantago*, a new group was installed as soon as possible to remain on the plants for the next period. The numbers installed on the host plants varied due to the weather and difficulty in securing sufficient numbers. The periods when leafhoppers were left on the plants were also irregular, due to the demands of other work and travel while conducting the experiment.

Results

The results as detailed in Chart No. 1 show that beet leafhoppers exposed to previously sprayed vegetation are killed in from three to six days. This toxicity continues effective for approximately one month after spraying.

The results as graphed in Chart No. 3 show that DDT as used gives a higher percentage of kill for leafhoppers on *Plantago insularis* than on *Erodium*. This is believed due to several factors. *Erodium* grows much more rapidly; therefore it subsequently presents a larger unsprayed area of new vegetation than does *Plantago*. During the period when the work was conducted, it was demonstrated that *Plantago* showed an increase in growth of 10 percent, whereas *Erodium* showed an increase of about 100 percent. In its natural habitat *Erodium* covers most of the soil, leaving very little opportunity for beet leafhoppers to come into contact with the bare soil which has also been exposed to the DDT spray. On the other hand, *Plantago*, being a sparse, wiry plant and scattered in numbers, leaves a large surface area of naked soil treated with DDT exposed to the leafhoppers.

The control installation was set up on a cage of *Erodium cicutarium* from a neighboring hill which had not been sprayed. Five beet leafhoppers were used, beginning February 2d, and were left on throughout the entire experiment. Five remained alive

14 days later, on February 15th; on February 21st four remained alive. By March 7th two were alive. The mortality among female overwintering beet leafhoppers, toward the end of February, in this control cage correlates with the lessening numbers found while sweeping in the field and seems to be associated with the normal time for overwintering females to die after they have laid their spring eggs. When the females started dying in the control cage near the end of February, this part of the experiment was terminated due to this natural mortality affecting the results of the experiment.

After the adult beet leafhoppers were removed from the cages containing the treated vegetation, the cages were left on the pots of vegetation to see how many nymphs developed in each installation. On April 18th, 77 days after the initial spraying, the cages were checked and all nymphs removed. In Cage No. 1 containing sprayed *Plantago*, no nymphs were found. In Cage No. 2, containing sprayed *Erodium*, three nymphs were found. In Cage No. 3, which was the unsprayed control pot, a total of 53 beet leafhopper nymphs were found in all stages of development, and also 46 *Agallia* nymphs. The *Agallia* eggs were probably laid in the vegetation, while it was still on the hillside and before it was placed in the cage. Cage No. 4, which contained sprayed *Erodium*, had five beet leafhopper nymphs; Cage No. 5 containing *Plantago* had no nymphs at all.

CHART No. 2

The Maximum and Minimum Temperatures and Rainfall as secured from the fire station at Coalinga, California, during the month of February

Date		Temperature °F. Maximum	Temperature °F. Minimum	Inches rainfall
Feb.	1	58	41	
	2	56	35	
	3	54	33	
	4	53	25	
	5	56	29	
	6	57	29	
	7	61	30	
	8	63	30	
	9	64	33	
	10	65	33	
	11	70	34	
	12	70	36	
	13	70	34	
	14	62	45	
	15	73	39	
	16	57	49	.65
	17	66	49	
	18	53	36	
	19	53	26	
	20	56	27	
	21	59	27	
	22	61	30	
	23	60	31	
	24	64	30	
	25	60	32	
	26	53	39	
	27	57	39	.65
	28	53	28	

Conclusions

In searching for the beet leafhoppers to remove them from the cages, it was found that they were difficult to locate. This is

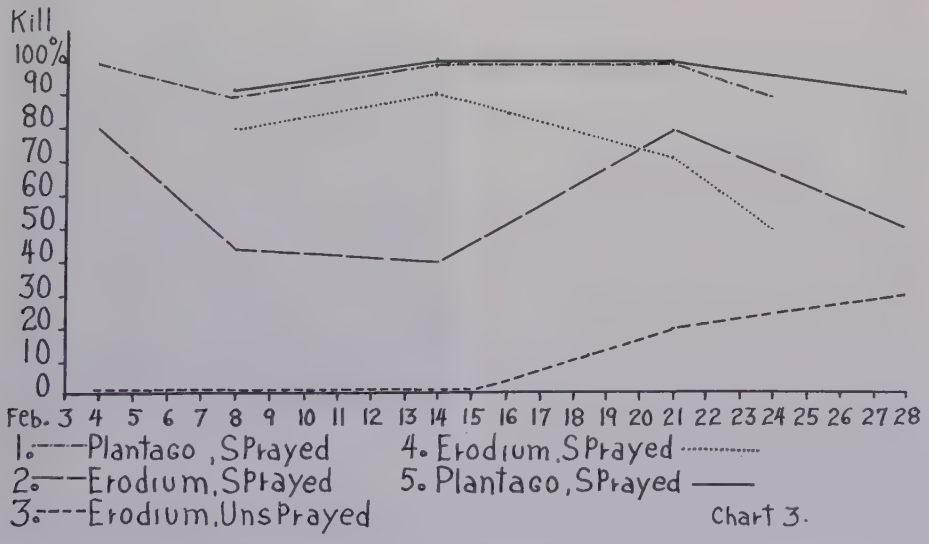


Chart 3.

due to their habit of hiding in crevices or under debris when death is approaching. This would account in part for our previous observations in the field, when very few leafhoppers were found under plants which had been sprayed.

The residual effect of DDT on beet leafhoppers on *Plantago* or slow growing plants is probably greater and lasts longer than on large, leafy, swiftly-growing plants such as *Erodium.*

It can be concluded from the results of this experiment, that under fairly cool winter temperatures the DDT as applied during regular control operations will remain toxic to leafhoppers for approximately one month after application. After a beet leafhopper has entered a previously sprayed area, it can be expected to die in approximately five days. Although it has been assumed that DDT has no ovicidal action, the nymphs which do hatch die soon after hatching if they are on previously sprayed vegetation. Approximately 10 times the number of nymphs will remain alive after hatching from unsprayed material as will from vegetation treated with DDT.

Khapra Beetle Suppression . . . A Progress Report

By H. M. ARMITAGE, *Chief, Bureau of Entomology, California Department of Agriculture*

The Khapra beetle, *Trogoderma granarium,* is the most recent addition to the list of insect species attacking stored agricultural products in California. It is native to India, Malaya and Ceylon and has a recent history of spread into Europe and the Orient. It is a pest of peanuts in Nigeria, of rice in Japan and brewer's maltings in England.

It was not until November, 1953, that its presence in the Western Hemisphere was recorded, when it was found heavily infesting bulk stored barley in two warehouses at Alpaugh and Angiola, respectively, in Tulare County, California. Subsequent survey showed it to be present also in Southern California, Arizona, New Mexico and Mexicali, Baja California. Infestations in these other areas are being subjected to the same suppressive measures as are those in California. Further extended federal-state-county survey has so far failed to show the presence of the beetle outside of this general area.

Where present its tremendous reproductive capacity under optimum conditions, its ability to hide out in incredibly small building crevices, its ability to survive long periods of adverse conditions without food, and its tolerance to remedial measures normally effective against other grain storage pest species, all have attracted national attention. State and federal quarantines designed to retard local spread or protect other uninfested states has created a situa-

Khapra beetle—larvae shown here came from behind bin walls after complete spraying with DDT.

tion making it mandatory that measures be designed and applied having complete suppression as their objective, in order to permit owners of infested premises to continue in business.

Immediately after finding the initial infestation in California, an effort was made to trace its source. It was found to have originated with used bags received from a warehouse which had unknowingly experienced heavy infestation seven years earlier in 1946. I say unknowingly since the infestation was apparently believed to represent an unusual increase in a species of dermestid commonly associated with grain storage in this State. So far as can be determined no specimens were collected and submitted for identification at that time. Had it been properly recognized then, it is possible the infestation would have been sufficiently incipient to lend itself more readily to suppression before it had the opportunity to spread to its present limits; however, at the present writing the initial inspection of over 20,000 premises lending themselves to infestation has resulted in finding only 209 actually infested. Although these premises are distributed among 17 counties, the situation can still be said to be relatively incipient.

The question of whether the Khapra beetle can be eradicated is, of course, a matter of opinion. Obviously it is not possible unless the effort is made. Without considering economic aspects of the problem, which in themselves would support such action, justification for the attempt lies in two important biological considerations. The Khapra beetle does not attack growing plants and therefore is never found under open field conditions. Also, while the adult beetle has well developed wings, they apparently are not used in extending their range by natural flight.

Any effort at eradication is therefore materially simplified, for infestation has been restricted to individual premises; the problem immediately resolves itself into devising effective means which can progressively be applied on that basis, until all infested premises have been treated. Attainment of the objective is naturally restricted by the degree to which it is possible to find all existing infestation, and the extent to which further outward spread can be prevented, during the interim, by uniform enforcement of regulatory safeguards. Both of these phases of the situation are receiving full attention.

Khapra beetle fumigation test No. 1—pre-fumigation spraying of adjacent surface area using five pounds malathion in 100 gallons diesel oil.

In support of attempted eradication, furthermore, infestation, though involving three states, is still relatively incipient. Intensive cooperative survey by federal, state and county field workers has shown the number of infested premises to be less than 4 percent of the thousands which have been inspected to date in the infested area as now defined. The premises examined represent those which offer opportunity for infestation.

It would appear that the majority of larger infested wholesale grain storage and redistribution centers has been found. Eradication measures are being extended first to these, since they do represent the greatest possibility of furthering spread by movement of host commodities, if not brought under control. More recent findings primarily are on-farm storage held for direct feeding or planting. From this standpoint they would seem to offer little likelihood of contributing to further spread; one exception includes used bags which might find their way back into channels of trade. This possibility is being fully safeguarded against by requiring their destruction or permitting their movement only after treatment using approved measures rigidly supervised.

When this problem first presented itself there was little or no information which served as a guide for development of effective eradication measures. It was early found, by trial and error, that contact or space

Khapra beetle fumigation—this warehouse of 4,000,000 cubic feet required 10 tons of methyl bromide, and nine and one-half acres of plasticized nylon covering at $2 per square yard ($60,000). Cost of the covering under contract was $37,500, cost of methyl bromide, $10,000, and miscellaneous labor and materials, $3,500. Gas was introduced at five pounds per thousand cubic feet during a 48-hour period; business was forced to close down for 10 days.

sprays were of little value in eradication no matter how effective the chemical used might be. It was found impossible to reach all larvae in the incredibly small building crevices in which they find it possible to hide. Also, their ability to hide under such conditions, for periods up to three years, in bridging periods of adverse temperature or host conditions, completely minimized any residual value which such chemicals might have. In addition their extremely high reproductive capacity has proportionately increased the number of survivors where such measures were applied.

The use of a highly volatile, penetrating fumigant has seemed to offer the only effective means of eradication. Here again the presence of larvae outside as well as inside infested buildings ruled out conventional fumigation, regardless of how tight the building might be, or might be made. It has become necessary, therefore, to resort to the rather unorthodox method of covering the entire infested structure with a gastight covering, to permit fumigation in its entirety.

Methyl bromide was selected as the fumigant for it has been proven, by federal and university research workers, to be biologically effective against all stages of the beetle. In addition it is nonexplosive, noninflammable and least hazardous to warm-blooded animals of any other fumigant studied. Against its use, however, was the experience of those engaged in grain fumigation; they had found dispersal of the bromide throughout any grain mass to be very poor except in the presence of forced mechanical recirculation. For that reason the exceptionally high dosage of five pounds per thousand cubic feet was established for the unusually long period of exposure of 48 hours, as now used.

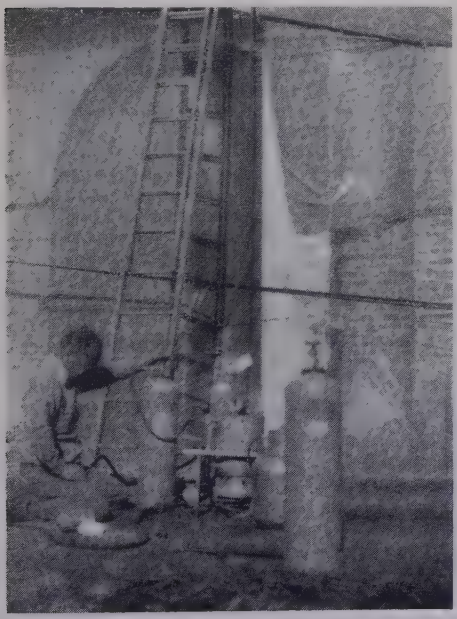
A series of large-scale tests was conducted under varying conditions, using both test insects and standard gas sampling-analysis methods, to assure that eradication was possible. The first test was restricted to an empty infested grain-storage warehouse. The second was conducted in the presence of large volume bulk grain using mechanical forced gas recirculation throughout the mass. A third was carried out under similar conditions, but without the use of forced recirculation. In no instances have any survivors been found among the test insects used, where the dosage and exposure followed have been maintained above the required limits. However, any reduction in either will be dependent upon further tests, in view of the high cost of covering the buildings and the need to assure complete mortality of all beetle stages under all conditions.

As results of these measures were found favorable, they have been extended to those infested premises meeting the same physical

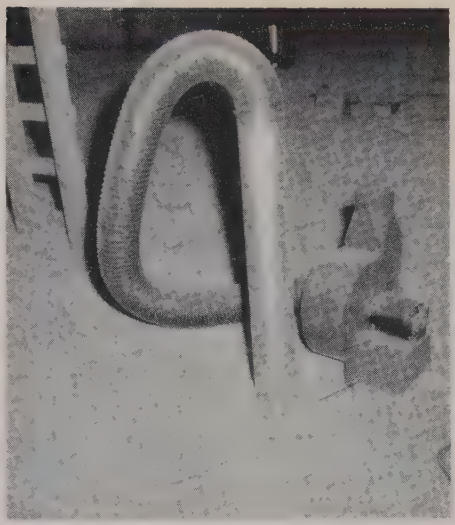
conditions. At the moment it is believed they can be effectively applied under any conditions, except in the presence of planting seed. It will be necessary to understand fully the tolerance of planting seed to the high dosage and exposure being used before applying these measures where volume storage of such seed is concerned.

This situation is being carefully studied in the California Department of Agriculture seed laboratories and by others. Seed of high oil content, such as corn, milo, sorghums, cotton and others, has been found particularly intolerant in the presence of moisture above 10 percent. Below that level the adverse effects are hardly significant. The latter is also true of most other seeds. It has been observed that most hard seeds are activated by the treatment and the germination of treated seed, actually higher than that of untreated.

As a further result of these large-scale tests, correlated with laboratory studies, federal authorities recognize the maintenance of a minimum concentration of two pounds of methyl bromide at the lowest point sampled, during any 24 hours of a 48-hour exposure period, as resulting in eradication where the Khapra beetle is concerned. Such concentrations, however, must be supported by



Khapra beetle premise fumigation—one of three gas introduction stations.



Khapra beetle fumigation test No. 2—close-up of one of 20 gas recirculation units installed 30 feet apart, 12 feet in from side walls, using six-inch down spouting carried 14 feet to near floor level; group of test insect cage-gas sampling probe installed in groups of three, down to 3 feet, 7 feet and 14 feet, respectively, in the grain mass (3,500 tons barley in one mass).

actual readings of gas samples taken at selected critical locations, at regular intervals throughout the full exposure period, representative of the structure and its content under fumigation.

Supplementing the fumigation, the surface area adjacent to the building under treatment, extending out at least 100 feet or to a natural barrier such as a road, irrigation ditch or other similar obstruction, is being thoroughly and repeatedly sprayed with malathion and diesel oil, using five pounds actual in 100 gallons.

With the means of eradication now established, it only remains to apply them to all existing infestation. Measures used in locating infestations have already been discussed. Application of the control measures is, however, being retarded by the cost and availability of facilities for their conduct. In California the cost is borne cooperatively by the State and the United States Department of Agriculture. In Arizona and New Mexico, owners of infested premises contribute one-third of cost.

Covering the structure for fumigation is proving the most difficult and expensive phase of these operations. In general it is handled under contract by competent licensed pest control operators, with unit of cost based on 1,000 cubic feet. Some of

the mill-storage structures have presented a maze of buildings, tanks, catwalks and towers comprising up to 4,000,000 cubic feet. Available gastight covering has been limited; as much as 14,000 square yards may be required for a single premises.

Wind has proven a hazard, causing losses which have proven expensive to the contractor and resulted in continued increases in the cost of covering, which has reached a maximum of $18 per 1,000 cubic feet, or in one instance, $47,500 for covering a single premises. Availability of methyl bromide has not as yet presented a problem; although as much as seven tons has been required for the initial charge in treating a single premises, with often a total up to 100 percent additional gas, being required where small premises are involved, and introduced at regular intervals, to compensate for sorption and gas loss.

In spite of all these difficulties, definite progress toward eradication is being made. Over one-third of all known infestations, representing over two-thirds of their cubic content, have already been successfully treated and officially released from infested status. The great part of these include larger establishments which might otherwise have been responsible for materially extending the area of infestation. Final attention will be extended the less important on-farm infested holdings as previously discussed.

Those responsible for providing the necessary funds for this effort in California have been most generous and understanding; these funds total in excess of $500,000 to date, with an additional $100,000 contributed by the United States Department of Agriculture. This amount, large as it is, is less than one-fourth of 1 percent of the annual farm value of the major crops being protected. If accepted as an established pest, a 1 percent loss would then equal over $2,000,000 annually. This is the final justification for attempting eradication, which it is believed can be accomplished using the measures outlined.

Readying methyl bromide heaters used in the introduction of gas from cylinders—each of the small heaters in foreground handles two cylinders; the large heaters handle four cylinders. In actual operation these heaters are placed at various points around the building in order to assure equal distribution of gas into the structure.

California Type Dairy Buildings

By A. E. REYNOLDS, *Assistant Chief, Bureau of Dairy Service, California Department of Agriculture*

Harvesting and processing California's milk crop is a chore which requires the full-time service of more than 300,000 men and women. Long before most of us are up in the morning and after many people are in bed at night, the dairymen are busy on 17,400 dairy farms, milking the 909,000 cows which supply consumers with all the well-known dairy foods.

Of the 6,703,439,000 pounds of milk produced during 1954 in California, 68 percent was consumed in its fluid state—this is called market milk or market cream. According to the requirements of the Agricultural Code, market milk must conform to rigid standards for purity and wholesomeness. Because fluid milk is quite perishable, every precaution must be taken to surround its production with sanitary safeguards, chief among which are the buildings and equipment necessary to the production of clean milk.

Milking barns and milkhouses, which qualify for market milk production, are expensive; this is one reason why market milk costs more on a pound for pound basis than that used for manufactured dairy products.

During the past 18 years much thought has been given to the design and utility of dairy buildings by universities, experiment stations, departments of agriculture, dairy associations, regulatory agencies and individual producers.

In 1937 the Director of Agriculture was empowered by law to establish rules and regulations and provide plans and specifications, at cost, for the construction of sanitary milk barns and milkhouses used in the production of market milk—"buildings shall be sound, readily cleanable and of sanitary construction—afford proper working space—admit sufficient light and ventilation."

Plans may be varied to suit climatic and other influencing factors in different sections of the State. When such rules, regulations, plans and specifications have been adopted—"*they shall be the standard building requirements for all market milk dairy farms operating in the same geographical area of the State.*" This requirement was of great significance to market milk producers during that prewar period, because it meant in effect that any market milk dairy farm, constructed and equipped in accordance with the plans adopted by the director, was in satisfactory compliance and thereby authorized to ship milk to any city or county maintaining an approved milk inspection service.*

Prior to the adoption of this legislation, each city or county milk inspection department had its particular dairy farm building standards. There were no uniform statewide building requirements, and the milk producer was obliged to conform to all provisions of all ordinances of all cities and counties where he sold his product. For example, a dairy farm (producer) sold his milk to a pasteurizing plant located in a city; the milk after pasteurization was distributed in four or five other cities, each of which enforced producer building requirements. Thus, the producer was subject to compliance with four or five different standards; four or five dairy inspectors representing separate agencies visited the dairy to enforce these different requirements.

This situation only created dissatisfaction and confusion and was partially responsible for the legislative action which established uniform building requirements. The first task which the director faced, to fulfill legislative intent, was to survey existing dairy building requirements at a local level. City

*Approved milk inspection service means a milk inspection unit and laboratory maintained in connection with a county or city or combination of either or both for the purpose of grading and inspecting market milk; and such service must conform to the rules and regulations established by the Director of Agriculture.

and county ordinances were reviewed, with the idea of incorporating into a uniform code all fundamental requirements necessary for clean milk production. The Agricultural Engineering Department of the University of California was consulted and agreed to participate in the formulation of such a program.

Regulation XXII (now Article 22, Administrative Code) was the result of this research. The regulation sets forth minimum construction standards for market milk buildings and includes such items as:

SITE—buildings to be located away from contaminating surroundings.

CORRALS—proper location, drained and graded.

MILKHOUSE—location, purpose, number of rooms, construction of pouring platform, floors, ceiling, doors and windows. Ventilation, drainage and refrigeration.

MILKING BARN—size, construction and arrangement of alleys, gutters, curbs, stanchions and mangers. Slope of floor and type of finish. Details on walls, ventilation, barn doors, wash sinks, painting, drainage, ramps, feed storage rooms and toilets.

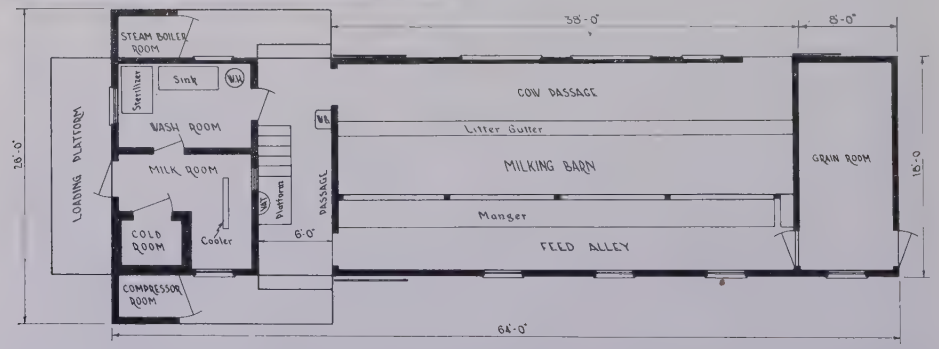
With these essentials agreed upon, the University of California prepared plans and specifications covering the various types of dairy buildings then in common use.

Meetings were held throughout the State, and all interested parties were given an opportunity to make recommendations and suggestions which they considered advisable to incorporate into plans. Dairy buildings were designed with three things in mind: the comfort of the cow, sanitation, and efficient operation.

The Agricultural Engineering Department of the University of California has worked in cooperation with the California Department of Agriculture in this planning service for the past 18 years. The Agricultural Code states that the director shall "provide plans and specifications at cost for the construction of sanitary milk barns and milkhouses."

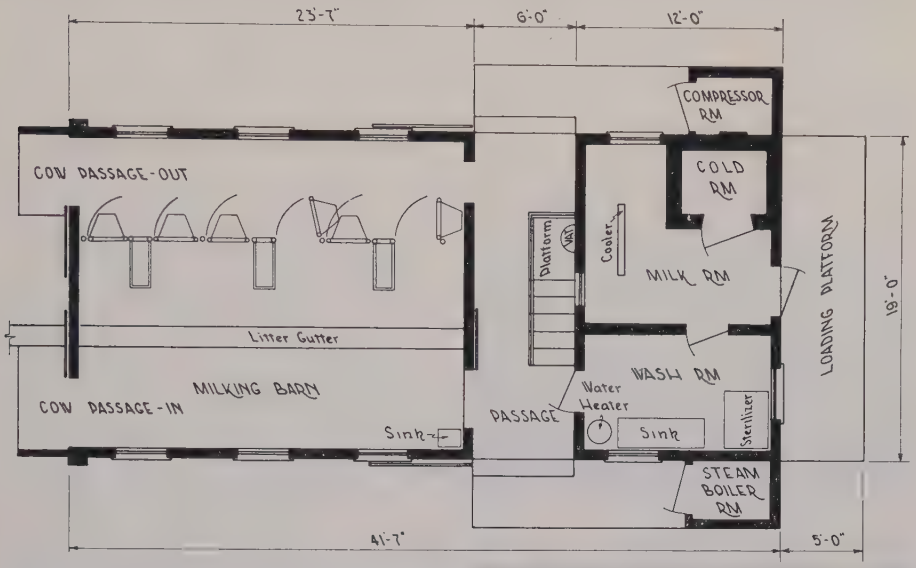
The University of California has now available eight detailed plans covering dairy structures and three milk goat dairy structures. These plans, approved by the Chief of the Bureau of Dairy Service, may be obtained from the University of California Agricultural Publications, 22 Giannini Hall, Berkeley; cost varies from $1 to $1.50.

Any deviation from the plans or from Article 22 must be authorized by the director. Few deviations have been requested, however, since the 11 plans offered by the University of California embody just about every conceivable method of construction of facilities for milking cows and goats. These plans are kept current by frequent contact between members of this department, approved milk inspection department personnel, county farm advisers, representa-



TWELVE-STALL SINGLE-STRING MILKING BARN, MILKHOUSE AND GRAIN ROOM. This plan includes a milking barn for 12 cows, a grain room for about 10 tons of sacked feed, and a milkhouse. The 12 stanchions are arranged in a single row. As many as 48 cows may be milked by dividing the herd into groups of 12 each. The number of stalls may be changed by altering the length of the barn, nine feet of length being equivalent to three stalls. Construction is concrete for the floor and lower three and one-half feet of the walls. Above this level, wood framing covered with horizontal siding is used. Plans for either metal or wood shingle roof are shown.

SIX-STALL WALK-THROUGH MILKING BARN AND MILKHOUSE. This plan shows a milking barn with six parallel, "walk-through" stalls, arranged in pairs, seven feet wide. It also includes a milkhouse. The barn length may be increased to give any desired numbers of pairs of stalls. The six stalls are considered sufficient for a herd of 40 to 60 cows. Details for construction of welded pipe walk-through stanchions and galvanized iron feed buckets and feed boxes are shown. The stanchions can be opened and closed from behind the cow by control rods. Construction is concrete for the floor and lower three feet-nine inches of the walls. Above this level, wood framing covered with horizontal siding is used. Plans for either metal or wood shingled roofs are shown.



tives from producer associations, local contractors and University of California Agricultural Engineering personnel asigned to this task.

Meetings are held in different California areas throughout the year, under authority of Section 497 of the Agricultural Code, which provides that the director shall from time to time conduct special refresher courses to train persons, employed by the department and cities and counties, in modern methods of milk production. From these meetings come suggestions for improvement in the plans which after careful study are incorporated into the approved plans.

Since dairymen do not all agree on a single "best" method for milking cows, the University of California offers several different arrangements. One such arrangement is the conventional stanchion type barn. Cows enter the barn, four, six, eight or ten at one time, are stanchioned, prepared for milking by being washed, udders cleaned and wiped dry; then the milking machine is applied and, after being "milked out," the cows are released to walk out a ramp or lane. A second string of cows then is started through the procedure, and so on until the herd is milked. All structures shown are typically Californian and differ from the east-

ern type buildings, where cows are housed indoors for several months during the winter.

Another approved type is the so-called walk-through barn. In this structure the cows enter the barn from the back, walk forward into a stanchion which is closed around the neck of the animal to hold her during the milking period. After being milked, the stanchion opens wide enough to let the cow walk through; she returns by a different route to the pasture, thus keeping the unmilked and milked cows separate.

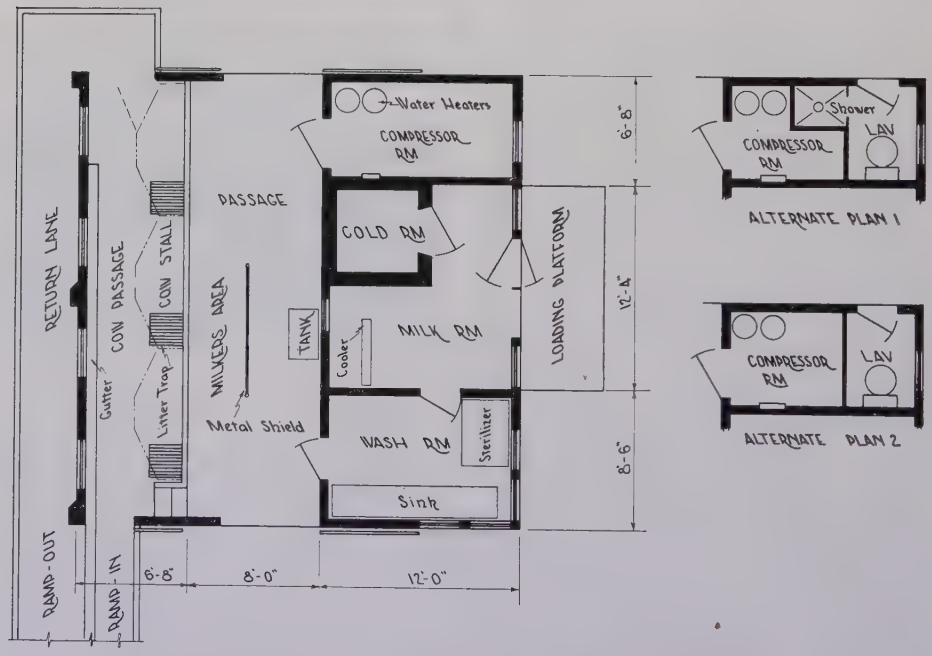
The type of milking barn currently very popular is known as the elevated tandem. In this type, the cows enter the structure at a level 30 inches above the pit where the

milker operates. The animals, which enter one at a time, are held in a stall until milked; after being milked, the stall is opened by a system of levers to permit the cow to exit, and another lever allows the second cow to take her place. There is an entrance and exit ramp for each string of cows. This system also keeps the milked and unmilked animals separate. One big advantage claimed for the elevated tandem is the elimination of stooping to prepare the cows, and apply and detach the milking machine. Also eliminated is the necessity for the milker to make his way in between standing animals in an attempt to attach the machine. The back of each stall is provided with a grate to prevent any litter from splashing.

Drainage is one of the most important items on the dairy farm. In selecting the site for dairy structures, this factor is given first consideration. Each of the structures illustrated is carefully constructed so that the barn, milkhouse, holding corrals and ramps can be washed down and kept clean at all times. High pressure water supply makes it possible to flush out these structures in a matter of minutes after milking is completed and during the milking process, as required.

All buildings are constructed of cement block or reinforced concrete. Inside walls are waterproof cement, troweled smooth for easy cleaning. Some of the more elaborate buildings are tiled on the inside for a more attractive appearance.

These sanitary buildings play an important part in bringing you a clean, wholesome, economical dairy food.



THREE-COW TANDEM MILKING BARN AND MILKHOUSE (FOR COMMERCIAL STEEL STALLS). This plan is for three cows milked in tandem, in elevated stalls. The stalls are 30 inches above the level of the milkers' area and milkhouse. Each stall is eight feet long, adaptable to most commercial equipment. The milkers' area is eight feet wide, so that a receiving tank and pump in the passageway can be used to collect the milk and deliver it to the cooler. The door to the milk room is wide enough to allow entrance of a bulk milk storage tank. If bulk storage tank is used, the cold box should be eliminated from the plan. The milkhouse may be reversed to provide a more satisfactory arrangement with relation to winds, storms, etc. Included are alternate plans for the compressor room to include a shower and lavatory. The drawings give a suggested layout for gates, lanes and holding corral to provide for efficient handling of the cows.

Eriophyid Studies XXIV

By H. H. KEIFER, *Bureau of Entomology, California Department of Agriculture*

Abstract: This installment contains the descriptions of four new species and one new subfamily. *Eriophyes prunidemissae* n. sp. from buds of *Prunus demissa* (Nutt.), occurring in California and Oregon; *Oxypleurites ferruginator* n. sp. rusting leaves of buckeye in the vicinity of New York City; *Heterotergum wilsoni* n. sp. on leaves of *Simmondsia* in Southern California; *Floracarus deleoni* n. sp. a rust mite on leaves of *Pithecolobium* in Florida; Nothopodinae, new subfamily, established for the reception of the Eriophyid genera *Nothopoda* and *Floracarus*.

Eriophyes prunidemissae Keifer, new species

Plate 245

Female 185-200μ long, 40-45μ thick, wormlike, color dull yellowish-white. Rostrum 30μ long, curved down. Shield 27μ long, 38μ wide; central design variable, often obscure: median line ending in a dart-shaped mark; admedians stronger to rear and usually joining with declivitous first ring; submedians faint, usually a slight outwardly oblique mark in front of dorsal tubercles; one or two curved marks below and ahead of dorsal tubercles; sides of shield granular, upper line of granules framing central area. Dorsal tubercles 17μ apart, a little ahead of rear margin; dorsal setae 30μ long, projecting up and forward. Forelegs 24μ long, tibia 3μ long, with short seta; tarsus 4.5μ long, claw 7μ long, tapering; featherclaw 4-rayed. Hindlegs 22μ long, tibia 3μ long, tarsus 4.5μ long, claw 8.5μ long. Coxae with some granules, anterior coxae contiguous. Abdomen with about 60 rings; microtubercles on all body rings; microtubercles somewhat elongate and rounded, 5-6 microtubercles in a 10μ distance measured transversely or vertically. Lateral abdominal seta 21μ long, on about ring 7; first ventral 21μ long, on about ring 19; second ventral 4μ long, on about ring 34; third ventral seta 21μ long, on ring 6 from rear. Accessory seta of moderate size. Female genitalia 20μ wide, 12μ long, coverflap with about 10 longitudinal furrows; seta 4μ long.

Male 185μ long, 45μ thick.

Type locality: Forest Home district, San Bernardino County, Cal. **Collected:** Sept. 15, 1955 by the writer. **Host:** *Prunus demissa* (Nutt.) (Rosaceae), Western choke-cherry. **Relation to host:** The mites live in the terminal buds but apparently have no relation to leaf galls as they have been found more numerous on choke-cherry shrubs which have no such galls on the leaves. **Type material:** A type slide and four paratype slides bear the above data. Two paratype slides come from this same host five miles east of McCloud, Shasta County, Cal., collected Aug. 31, 1953 by the writer. Two paratype slides from this same host were collected Aug. 24, 1955 at The Dalles, Oregon, by Dr. K. G. Swenson.

Eriophyes prunidemissae is a nondescript mite with numerous slight variations, especially as to clarity of shield design, that is allied to *prunandersoni* by the possession of the diagonal mark in front of the dorsal tubercles. Both species have a 4-rayed featherclaw. The new species differs from *prunandersoni* by having a larger beak, larger microtubercles, and the more obscure shield design. This mite is described at this time because of increased interest in budmites on *Prunus* spp.

Oxypleurites ferruginator Keifer, new species

Plate 246

Female (protogyne) 180-200μ long, 40-45μ wide, 35-40μ thick; flattened fusiform; color dull yellowish. Rostrum 21μ long, projecting down. Shield 43μ long, 42μ wide, subtriangular: Design obscure, admedians faintly present, a submedian distinct ahead of dorsal tubercles and another distinct further to side; anterior lobe somewhat acute, rounded apically, transversely truncate in side view with a slight ventral projection. Dorsal tubercles 22μ apart, on rear margin; dorsal setae 13μ long projecting back and a little centrad. Forelegs 28μ long, tibia 5.5μ long, with seta; tarsus 6μ long, claw 7μ long, apically knobbed; featherclaw 4-rayed. Hindlegs 26μ long, tibia 5μ long, tarsus 6μ long, claw 7.5μ long. Coxae set with curved lines, anterior coxae contiguous. Dorsum of abdomen with about 25 tergites which are broad and lack microtubercles; tergites forming a central longitudinal ridge; laterally the tergites project into short lobes. Abdominal sternites 65-70 in number, completely set with small microtubercles. Lateral seta 22μ long, on about sternite 11; first ventral seta 35μ long, on about sternite 25; second ventral

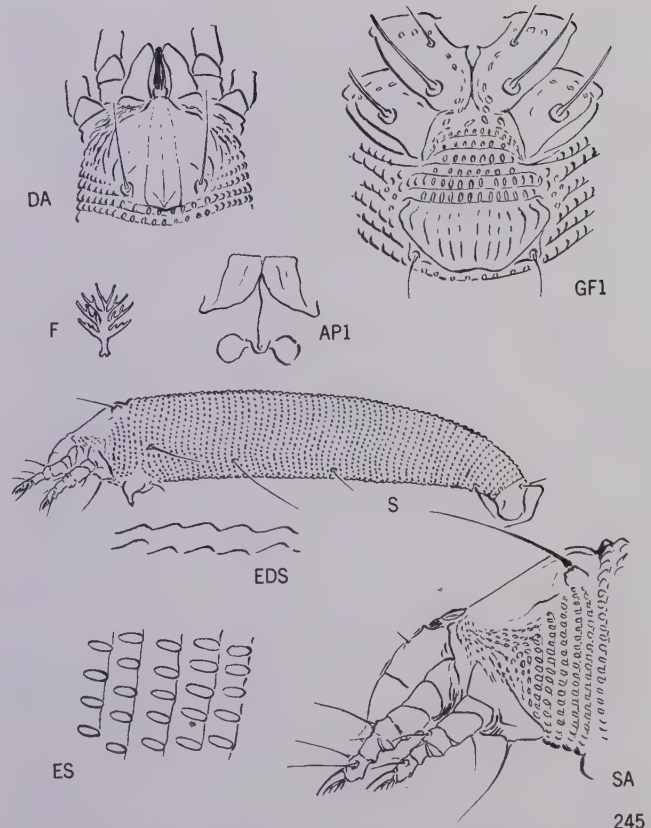


PLATE 245—ERIOPHYES PRUNIDEMISSAE N. SP.

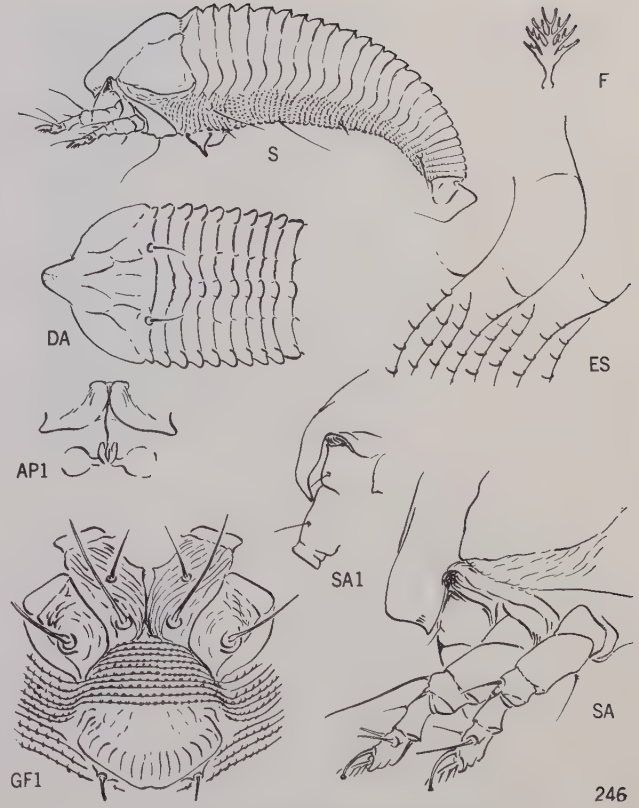


PLATE 246—OXYPLEURITES FERRUGINATOR N. SP.

12μ long, on sternite 42; third ventral 22μ long, on sternite 5 from rear. Accessory seta absent. Female genitalia 20μ wide, 16μ long, coverflap with 14-16 longitudinal furrows; seta 14μ long.

Deutogyne about same dimensions as protogyne; tergites narrower than protogyne and lacking middorsal ridge and side lobes; anterior shield lobe curving half-way down rostrum and ending in a recurved point.

Male similar to protogyne; 160μ long.

Type locality: Bay Ridge, Brooklyn, N. Y. **Collected:** Aug. 10, 1955 by Lt. M. E. Tinker. **Host:** *Aesculus* sp. possibly *glabra* Willd. (Hippocastanaceae), buckeye or horse chestnut. **Relation to host:** the mites feed on the underside of the leaves causing rusting. **Type material:** A type slide and five paratype slides bear the above data. In addition there is the dry material from which the slides were made. This is the first *Oxypleurites* described from *Aesculus* on the east coast of North America. The species called attention to itself by severely rusting buckeyes in the vicinity of New York City, particularly around Army installations. The new species differs from *Oxypleurites aesculifoliae* (K.), the rust mite on California buckeye, mainly by the shape of the anterior shield lobe on the protogyne. In lateral view this lobe on *aesculifoliae* is somewhat turned up and subacuminate. On *ferruginator* the lobe turns down and is transversely truncate.

Heterotergum wilsoni Keifer, new species

Plate 247

Female 110-125μ long, 45μ wide, 35-40μ thick, fusiform, orange in color. Rostrum large and downcurved, 40μ long. Shield 40μ long, 35μ wide, anterior lobe broad and blunt; design absent except for a short inwardly curved line on inner side of dorsal tubercles. Dorsal tubercles 27μ apart, on rear margin; dorsal setae 7μ long, projecting backwards. Forelegs 30μ long, tibia 5μ long, with seta; tarsus 5μ long, claw 8μ long, tapering; featherclaw 6-rayed. Hindlegs 26μ long, tibia 4.5μ long, tarsus 5μ long, claw 8μ long. Coxae with a few lines, the anterior coxae contiguous. Abdomen immediately behind shield with a dorsal continuation of two to four of the sternites; broad tergites about 8 in number, the total tergites numbering about 16; sternites approximately 40 in number, microtuberculate. Lateral seta 16μ long, on sternite 3 behind shield; first ventral 22μ long, on sternite 12; second ventral 7.5μ long, on sternite 22; third ventral 12μ long, on sternite 4 from rear. Accessory seta minute. Female genitalia 20μ wide, 12μ long, coverflap with 12-14 longitudinal furrows, seta 23μ long.

Male 110μ long.

Type locality: Aguanga district, Riverside-San Diego County line. **Collected:** Sept. 14, 1955 by the writer. **Host:** *Simmondsia californica* Nutt. (Buxaceae), Jajoba. **Relation to host:** the mites live among the hairs on the leaf surfaces, causing no apparent damage. **Type material:** A type slide and five paratype slides bear the above data. In addition there is the dry material from which the slides were made. I am pleased to name this very tiny mite for Norton S. Wilson who originally discovered it and called my attention to it. The genus to which this mite belongs is characterized by the dorsal extension of the anterior sternites. The genotype of *Heterotergum* is *gossypii* K., a mite damaging cotton in Brazil. From the genotype the new species differs in having relatively larger tergites and in the larger size of the shield lobe as compared to the shield size. The host, *Simmondsia*, is the only native representative of the Buxaceae in California.

Floracarus deleoni Keifer, new species

Plate 248

Female 125-140μ long, 40-50μ thick, fusiform, color in life probably light yellowish-white. Rostrum 17.5μ long, projecting down. Shield 38μ long, 45-50μ wide; median line complete; admedians complete, connected to median by cross lines at rear ¼; a partial submedian inside dorsal tubercles; an outwardly diagonal line from dorsal tubercles extending through one or two body rings; anterior shield lobe broad and blunt, composed of an upper and lower ridge which ridges extend caudally to lateral shield lobes. Dorsal tubercles somewhat ahead of shield margin, 26μ apart; dorsal setae 5μ long, projecting back and diagonally centrad. Forelegs 20μ long, tibio-tarsus 7μ long, with a pair of large setae; claw 4.5μ long, on innerside of tibio-tarsus, knobbed; featherclaw apparently 5-rayed. Hindlegs 17.5μ long, tibio-tarsus 5.5μ long, claw 4.5μ long, arising from usual dorsal position. Anterior coxae fused into one structure with suboral plate, spinulate across anterior ⅔; setae I missing. Abdomen with plus or minus 45 rings; microtubercles obscure dorsally anteriorly, becoming more prominent ventrally and caudally; microtubercles principally elongate streaks ending in a dot. Lateral seta 14μ long, on ring 2 behind shield; first ventral 14μ long, on about ring 14; second ventral 5μ long, on ring 25; third ventral 15μ long, on ring 5 from rear. No accessory seta. Female genitalia 19μ wide, 15μ long, basal area of coverflap with granular surface; seta 5μ long.

Male 125-140μ long.

Type locality: Coral Gables, Fla. **Collected:** July 19, 1955 by Donald De Leon. **Host:** *Pithecolobium guadaloupense* Chapm. (Leguminosae). **Relation to host:** The mites

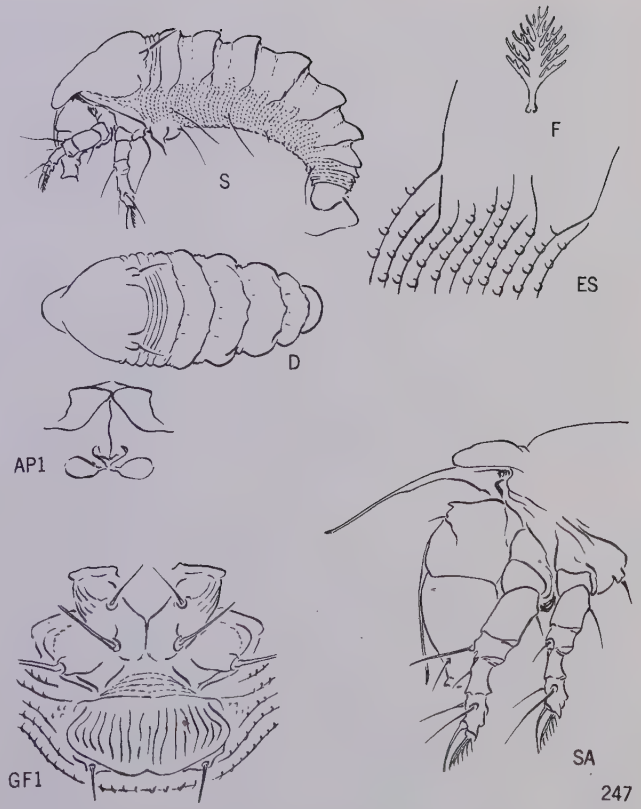


PLATE 247—HETEROTERGUM WILSONI N. SP.

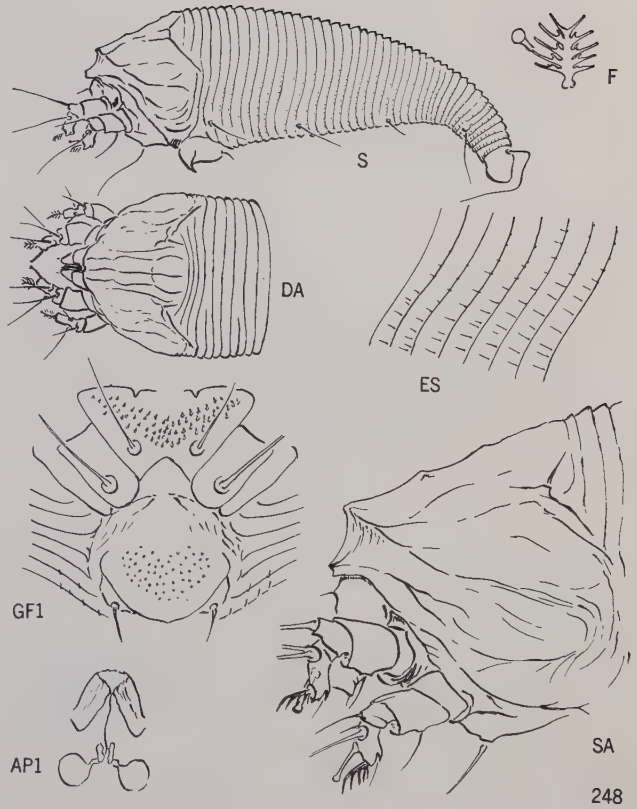


PLATE 248—FLORACARUS DELEONI N. SP.

function as rust mites on the leaf surface. **Type material:** A type slide and ten paratype slides bear the above data. (An alternate spelling of the host genus is *Pithecellobium*). The mite species is named for its collector who has sent me a number of very interesting Eriophyids. This is the second species of *Floracarus*, the genotype being *calonyctionis* K., also from Florida. From the genotype the new species differs by having a much larger lobe over the rostrum, a less elaborate shield design, and by lacking transverse lines on the female coverflap. Both species share the peculiar microtubercles, and the inwardly directed anterior claws.

Floracarus deleoni is the third species which I have described that has a tibiotarsus (or lacks the tibia), with a pair of extra large tarsal setae, which lacks coxal seta I, and which has the anterior coxae fused with the suboral plate. The first species, *Nothopoda rapaneae* K. (Bul. Cal. Dept. Agr. 40:96, 1951), possesses no projection over the rostrum, and the anterior claw has the normal frontal position. The second species, *Floracarus calonyctionis* K. (Bul. Cal. Dept. Agr. 42:69, 1953), has been characterized above. In addition I have two undescribed species from Mexico on unnamed hosts that belong to *Nothopoda*. Previously I have considered *Nothopoda* to belong to the Eriophyinae, and *Floracarus* to belong to the Phyllocoptinae by the respective absence or presence of a lobe over the rostrum. But the direct relationship between these species signified by the reduced or absent tibia, the absence of coxal seta I, and the fusing of the anterior coxae with the suboral plate, cannot longer be ignored. While the information on mites of this type is still extremely meagre, it now seems likely that we are dealing with a peculiar series of mites that should be recognized as a distinct taxonomic entity. These mites would seem to be a tropical American development that reaches the United States at the southern tip of Florida.[1] I therefore propose the following new Eriophyid subfamily:

[1] *Aceria essigi* (Hassan) has frontal coxae that are partially fused and that suggest the Nothopodinae. However, this mite possesses the frontal coxal seta, that is, seta I, and also has distinct tibiae on all legs.

Nothopodinae Keifer, new subfamily
Type genus: **Nothopoda**

Following H. Roivainen's designation of Eriophyid subfamilies (Ann. Ent. Fenn. 19(2):83, 1953) the new subfamily is defined in the following key:

1. One or two frontal setae on shield in addition to usual dorsal setae arising on rear part of shield; subdorsal abdominal setae present or absent ..... 2.
1. Shield with only the rear pair of dorsal setae, or these absent; subdorsal abdominal setae never present ..... 5.
2. Female genitalia on rings 10 to 12 Novophytoptinae Roiv.
2. Female genitalia closer to coxae ..... 3.
3. Shield not projecting at all over rostrum ..... Phytoptinae K.
3. An anterior lobe over rostrum ..... 4.
4. Subdorsal abdominal setae present Sierraphytoptinae K.
4. Subdorsal abdominal setae absent Nalapellinae Roiv.
5. Rostrum large, projecting straight down and tapering; chelicerae abruptly bent down near base Rhyncaphytoptinae Roiv.
5. Rostrum of various sizes, usually relatively small, when large it and chelicerae evenly curved down, the chelicerae never abruptly bent ..... 6.
6. Legs reduced by lacking a distinct tibia; coxal seta I missing; anterior coxae fused with suboral plate Nothopodinae K., new subfamily
6. Legs with usual five segments, if rarely reduced the tibia distinct; or coxal seta I present; or anterior coxae distinct below, unfused; or a combination of these characters ..... 7.
7. Anterior shield lobe over chelicera base thin, minute, or absent; body wormlike with rings similar dorsoventrally, at least anteriorly, and not followed by abruptly large back plates Eriophyinae Nalepa
7. Anterior shield lobe prominent, covering more than the chelicerae base; or body fusiform with tergites broader and less numerous than the sternites, the tergites at most preceded by few narrow rings similar to sternites; or a combination of these characters Phyllocoptinae Nalepa

DESIGNATIONS ON PLATES

AP1—Internal female genitalia
D—Dorsal view of mite
DA—Dorsal view of anterior section of mite
EDS—Side view of dorsal microtubercles
ES—Lateral rings and microtubercles
F—Featherclaw from below
GF1—Ventral view of coxae and female genitalia
S—Side view of mite
SA—Side view of anterior section of mite
SA1—Lateral view of anterior shield lobe of deutogyne

Editor's Note:

Eriophyid Studies XXIII appeared in this Bulletin Vol. XLIV (3), p. 126-30, Oct. 17, 1955. In XXIII plates 243 and 244 are unfortunately interchanged. To read these illustrations correctly transfer the right hand illustration to the left, and the left one to the right. This error is being corrected in the reprints.

Current Insect Notes

By H. M. ARMITAGE, *Chief, Bureau of Entomology, California Department of Agriculture*

In the following comment, attention is called to the finding for the first time in California, of several species of potential economic importance to agriculture; also several previously reported but not widely distributed in the State which have been found in new areas or which are attracting unusual attention from the suppression standpoint.

Specimens of the lettuce root aphid, *Pemphigus bursarius*, were received for identification on July 15th, from Lloyd F. Plesse, Deputy Agricultural Commissioner of Santa Clara County, which were reported to have been collected on poplar in San Jose. This is the first reported occurrence of this species in California. On September 1st, it was again submitted from Santa Cruz County at a point 30 miles southwest of the first record. The second finding was made by L. R. Gillogly, and also associated with poplar. F. L. Blanc, Department entomologist, states that the winged adults are without cornicles. The head, thorax, and appendages are dark brown to black. The abdomen is gray-green with dark markings and lateral spots. The entire body is covered with a white mealy wax. Literature shows poplar (*Populus* spp.) to be the winter host on which the aphid produces one or two galls on the leaf petioles, consisting of irregular tuberous swellings about one-half inch in diameter, tapering to a blunt point at the tip. In the spring, migrants are reported to move over to the roots of lettuce, carrot, lambsquarters (*chenopodium* spp.), *Sonchus* spp. and *Lampsana communis*. As winter approaches they move back to poplar. This species has been reported as doing economic damage to lettuce in Montana in 1940. Its presence in California is not too far from the heavy lettuce producing area in the Salinas Valley. While this type of insect does not lend itself to practical eradicative measures, its reported occurrence is being made the subject of a state-county cooperative survey to determine the extent of its occurrence. At the same time the assistance of the University of California has been solicited in developing effective control measures.

In January, 1954, specimens of a psyllid collected by D. Bingham of the State Nursery Service on *Acacia* sp. in a nursery in Belmont, San Mateo County, were identified by an eastern authority as *Aphaloroida* sp. As a result of a review of these specimens in July, 1955, by Dr. D. D. Jensen of the University of California and of other specimens subsequently collected following the first finding, he decided that it represented *Psylla uncatoides*, a species described from New Zealand and not previously reported in North America. A quick survey by state, county and university entomologists showed that it was quite widespread in the State on *Acacia* spp., its presence apparently having gone unnoticed. The winged adults are pale yellow to dark orange with black markings on the body. The forewings have a dusky marking on the tip half. The nymphs are pale yellow to yellow with transverse dark stripes on the abdomen, dark spots on the thorax, and have

many heavy black spines over the body. In rapid sequence it was found at La Mesa in San Diego County in April, 1955; in Golden Gate Park in San Francisco, at Camarillo in Ventura County, and at Benicia in Solano County in May; at Berkeley in Alameda County, Montecito in Santa Barbara County and San Jose in Santa Clara County in June; and at Sonoma in Sonoma County and Westwood in Los Angeles County in July. It has so far been reported present on *Acacia melanoxylon*, *Acacia* sp., and *Albizzia julibrisin*. It carries the common name Albizzia psyllid. When present in abundance it causes browning of young foliage. Also secretion of honeydew results in development of sooty mold fungus which has a further smothering effect on the host besides creating unsightly appearance in the host. The indicated widespread distribution precludes any thought of eradication even if thought otherwise practical.

On June 15, 1955, Dr. H. T. Osborn, Department Survey Entomologist, picked up a leafhopper on elm on the Stanford University campus at Palo Alto, Santa Clara County, which was found to be *Macropsis ulmi* (Scott). The adults are greenish (female) to greenish brown (male) in color with a black spot on the outside of the hind tibia near the base and occasionally a black spot on the face near the eye. They feed on the twigs and are usually found at the base of the leaf petiole. No remedial measures seem practical or are contemplated. This is the first record of the occurrence of this species in California. It is native to Europe and has previously been reported in this Country only from Pennsylvania and the District of Columbia. Elm is its only known host. It causes little if any detectable damage to its host and its only claim for attention lies in the fact that it is a near relative of *M. trimaculata*, a known vector of peach yellows and little peach. Neither of these important virus diseases is known to occur in this State.

On July 29th, Ward B. Saunders, Agricultural Commissioner of San Benito County, submitted larval specimens to Sacramento for identification which were found to be the Oriental fruit moth, *Grapholitha molesta*. They were taken in peach on yard trees on his home premises in Hollister. This is the first report of this species from this county and the second from the coastal area, the first being at San Jose in Santa Clara County in 1947. The Oriental fruit moth was first found in California in 1943. At that time survey showed it well established in Southern California with scattered infestations throughout the San Joaquin and Sacramento Valleys. However, outside of Orange County, where it heavily infested noncommercial plantings, it to all purposes died out until just recently when a flare-up in late season peaches occurred along the Kings, Tulare, Fresno county lines. It would appear that permanent establishment has occurred and pest importance very possibly just awaiting more optimum climatic conditions. Possibly it has taken 10 years to orient itself with California conditions and we may expect to see more of it as a pest in the future. The situation is being watched carefully by representatives of the University of California, who are aiding the growers in planning and conducting control programs.

Specimens of the dusky veined walnut aphid, *Callaphis juglandis*, were submitted for identification on August 30th, by R. V. Emparan, County Agricultural Inspector, taken on *Juglans* sp. at King City, Monterey County. The infestation was reported as heavy and causing economic injury to the host. This infestation is the first reported from this county and occurs approximately 90 miles southeast of the nearest previous infestation at San Jose in Santa Clara County, where it was first found in the State on August 5, 1952. At that time a preliminary survey showed infestation extending into Alameda County at Niles under conditions precluding any successful attempt at eradication, even if such a species was amenable to such effort.

The rapidity with which the spotted alfalfa aphid, *Therioaphis maculata*, formerly called yellow clover aphid, is spreading throughout the State, is almost unbelievable. First reported on burr clover in San Diego County on February 4, 1954, damaging populations were found almost simultaneously in Imperial and Riverside Counties. During that year spread was reported into all Southern California counties excepting Santa Barbara with general light to damaging populations in most counties. In January, 1955, a single specimen was picked up at Edison in Kern County for the first record north of the Tehachapis. By June this had expanded to general damaging populations on all alfalfa plantings in the county. In the interim, the University of California reported infes-

tations in Kings, Tulare and Fresno Counties with infestation now general in these areas. In rapid order its presence was recorded in Madera, Merced and Stanislaus Counties. The next finding in Tehama County represented a jump of 200 miles to the north and represented the northern limits of the Sacramento Valley. Subsequently infestation has been reported in this intervening area at Tracy in San Joaquin County on September 6th. In the meantime infestation had been moving up the coast with confirmed reports of its occurrence in San Luis Obispo and Monterey Counties. It has been observed that treated fields become reinfested within days from adjacent untreated fields. Generally speaking this rapid spread throughout the length and breadth of the State in less than two years is attributed to natural flight aided by wind. However, there is ample evidence in the repeated finding of first infestations along arterial highways, that it has been carried by transportation of newly cut hay originating with infested premises.

The pear psylla (*Psylla pyricola*) is continuing its southward spread, Trinity and Shasta Counties having recently reported infestation. Specimens were found infesting pear at Burnt Ranch in Trinity County on July 1st by Dr. H. T. Osborn, State Survey Entomologist. This location is approximately 17 miles southwest of the nearest previously reported infestation at Willow Creek in Humboldt County. On August 1st, State Survey Entomologist W. W. Wiard, submitted specimens collected on Soda Creek Road in Shasta County at a point 40 miles southwest of the nearest previously reported find in Siskiyou County. This brings to seven the number of counties in which established infestation has been recorded, forming a contiguous group from the Oregon line south. With the exception of that occurring in the Potter Valley in Mendocino where 400 acres are involved, none of the infestations to date have concerned commercial plantings. However, they are closely approaching such an area in northern Lake County.

An intensive state-county cooperative trapping survey, initiated in June, has shown the walnut husk fly, *Rhagoletis completa*, to be widely distributed in the Sonoma Valley in Sonoma County, throughout its length of 15 miles and width of two miles. Indication of its presence in this area was first reported in the fall of 1954, too late in the season to permit an adequate survey at that time. Confirmation of its presence and the extent to which it occurs is of importance not only to walnut growers but to growers of late peaches. Its finding represents its first recorded appearance in Northern California and apparently already too widely established to permit any serious attempt at eradication. Measures designed to hold down their numbers during the current season were applied during the period of survey. During the latter, sticky-side pasteboard traps baited with ammonium carbonate were found effective in detecting its presence. In addition to this area and in immediately adjacent valleys, traps were installed and serviced in practically all walnut producing counties in the northern part of the State. As a result infestation was also discovered in Frazier Park in Kern County, representing the first indicated natural spread from Southern California into the northern part of the State. The infestation in Sonoma County undoubtedly resulted from direct inadvertent carry in.

The results of suppressive efforts being directed against the Khapra beetle, *Trogoderma granarium*, in California are beginning to look encouraging. Federal-state survey during the past 10 weeks has included the inspection of nearly 10,000 premises, in 14 counties, offering opportunity for infestation with only 46 being found infested. These new infestations have been grouped in Imperial and Kern Counties which have represented the centers of earlier infestations. All known infestation has been eliminated in Kings, Madera and Sutter Counties. Only one new county has been added to the infested list by the finding of an infestation at El Cajon in San Diego County on August 24th. All of the new infestations have been represented by small on-farm storage for direct feeding or planting. No new large storage or distributing warehouses have been recorded as infested. Of the 206 infestations so far recorded in the State, 62, representing approximately 30 percent of the total number of properties but in size representing nearly 75 percent of the total cubic content subject to fumigation, have been treated and released from infested status. Survey will continue with competent personnel, eventually riding out every road in the State and repeatedly inspecting every premise on which grain or agricultural seed is held, regardless of the amount.

Dematophora Root Rot

By ABDUL HAMID KHAN,[1] *Forest Botanist, Pakistan Forest Research Institute, Abbottabad, Pakistan*

The root disease caused by *Rosellinia* (*Dematophora*) *necatrix* attracted attention in Europe about 75 years ago where it caused severe damage to grapes (3). It was recognized in California in 1929 (5) at which time it was well established in apple orchards in Santa Cruz County. The disease has been found in at least 15 counties and two nurseries (2, 4, 5, 6, 7). It was reported in several places in eastern United States around the turn of the century, but no mention of it seems to have been made there during the last 45 years.

The writer studied the disease at the University of California during the years 1946 to 1948.

Symptoms and Signs

The above-ground symptoms are, in general, similar to those caused by other root rots or rodent damage. Plants which die quickly often retain their leaves for some weeks after death. When the decline is slower the leaves are sparse and small, and growth is brought to a near stand-still before the plant succumbs. In wet weather the fungus may appear as loose, whitish mycelium at the soil surface (Figure 1, lower left) or as a dark mat on the base of the stem from which arise the white-headed coremia. (Figure 1, lower right.)

Below ground the cortex, wood and adjacent soil are invaded by the loose cottony mycelium (Figure 1, lower left) which later forms plaques and loosely aggregated strands but not clearly defined fans or rhizomorphs. A dark crusted mat may form on the root surface, as on the lower stem.

Perithecia or fruiting bodies in which ascospores are produced have not been seen in the field in California (1), and the conidia (spores produced on the coremia) appear to play no part in dissemination of the fungus.

The mycelium grows freely through bark and wood, both inter- and intra-cellularly, showing a preference for phloem, cambium, and medullary rays. A good diagnostic feature is a pronounced swelling at the distal ends of old hyphal cells (Figure 1, upper right). When pieces of affected roots or bark are placed in a moist chamber in the laboratory without any treatment to suppress competing organisms the mycelium grows freely out of them (Figure 1, upper left). This is helpful in diagnosis and in obtaining pure cultures of the fungus.

Other Characteristics of the Disease

Unlike Armillaria root rot, the Dematophora disease spreads freely in cultivated areas, due mainly to the marked resistance of the fungus to drying. It can survive in small pieces of wood and bark for more than a year without addition of water. Thus it can easily be moved from place to place in the orchard or elsewhere by cultivation or irrigation practices.

The fungus is killed in laboratory cultures by a continuous temperature of 93.2 degrees F. or above for 13 days.[2] This may help to explain the fact that in California the disease has been more severe in cooler districts near the coast than elsewhere.

Host Range

All told, *Dematophora* (*Rosellinia*) *necatrix* has been reported on about 170 species and varieties of plants representing 63 genera and 30 families of higher plants and three algae. The hosts named in this paper will be

[1] The author is grateful to H. Earl Thomas and Stephen Wilhelm, Department of Plant Pathology, University of California, for assistance in this work and in the preparation of the manuscript.

[2] Khan, Abdul Hamid. Growth and nutritional requirements of *Rosellinia necatrix*. In manuscript.

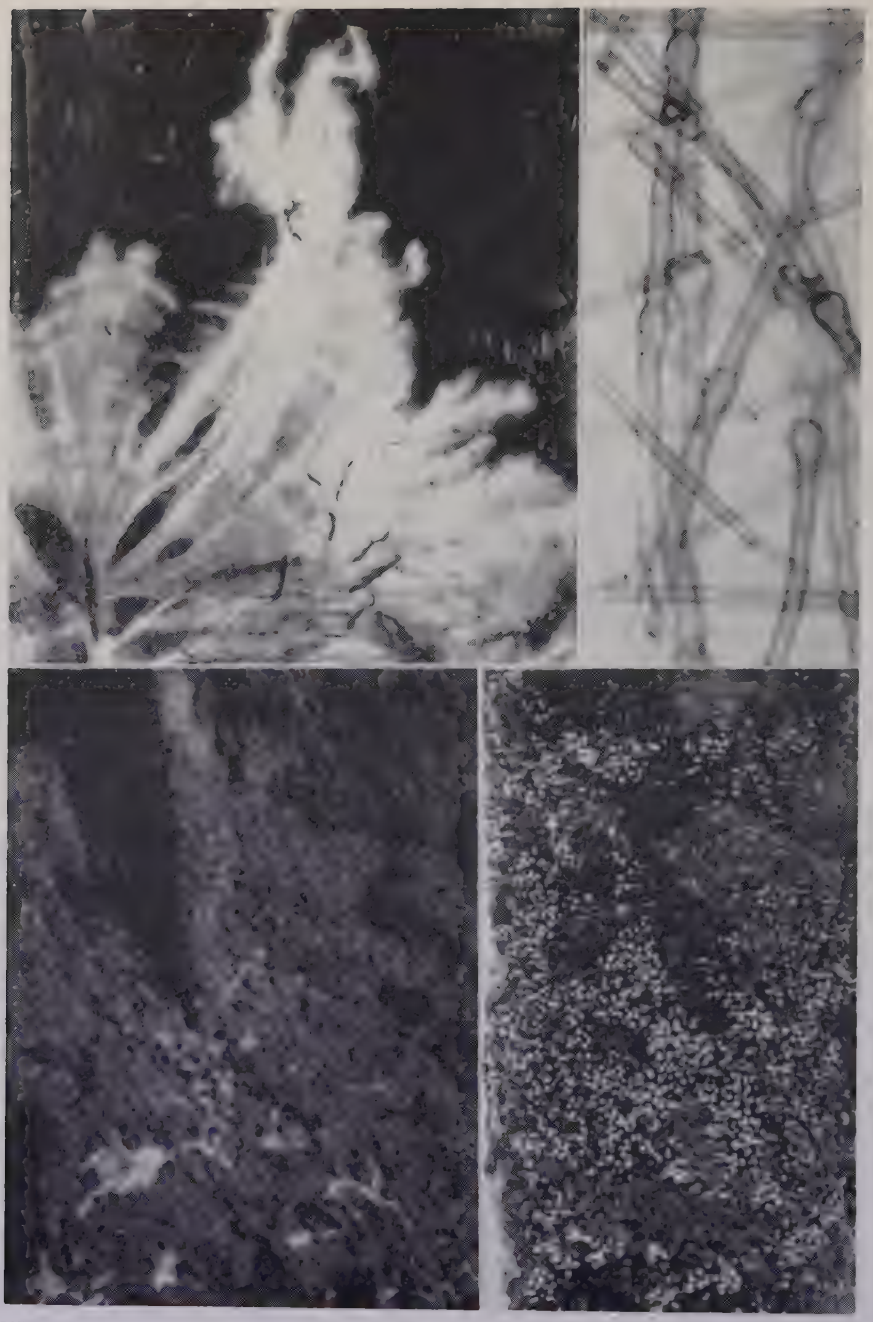


FIGURE 1. *Dematophora necatrix.* Below left, white mycelium in moist soil adjacent to roots and stem of young apple tree in midwinter. Below right, coremia or small clusters of spores on erect columns of mycelia on surface of infected root exposed to moist air. Above left, mycelium growing from infected root on surface of glass moist chamber. Above right, mycelium with characteristic swellings in hyphal cells (x 700)

limited to those determined by observations and inoculation tests made in California. Plants were exposed to the fungus in pots in the greenhouse, in large boxes of soil outdoors, and in two field plots in Santa Cruz County (established by Harold E. Thomas, then on the staff of the University of California, and associates). The field plots were in apple orchards where trees had been killed by the fungus in considerable areas. One of these plots was maintained for more than 10 years.

At one time or another, seven isolates of the fungus obtained from five counties and from apple, cherry, peony, pear, and walnut were used as inoculum. Although a few differences were seen in culture there was no conclusive difference in pathogenicity.

The time required to kill small plants varied from two weeks to several months. Occasionally individual seedlings of susceptible species (peach, pear) survived in the field in infested areas for several years. Planting in soil already infested led to earlier death than infesting soil around plants with roots well established. Young plants were killed more quickly than older plants of the same species. Potted plants in the greenhouse were killed more readily than plants in boxes out of doors.

Among the plants of general interest, moderate to high susceptibility is found in alfalfa, almond, apple, apricot, blackberry, cherry, citrus, cotoneaster, fig, grape, peach, pear, quince, strawberry, and walnut.

Apple seedlings of the Golden Delicious and McIntosh varieties and the clonal rootstocks, East Malling I, II, IV, V, VII and IX were susceptible. Since the conclusion of the writer's work, some resistance has been found in *Malus floribunda* and *M. toringoides* (6).

Boysenberry and loganberry were killed in a field plot where Himalaya and Young blackberries seemed to have adequate resistance. The native blackberry, *Rubus ursinus*, and red raspberry growing in pots were stunted but not killed.

Mahaleb, mazzard and sour cherry rootstocks were susceptible.

Rough lemon, sweet and sour orange, trifoliate orange and Windsor grapefruit were susceptible. Trifoliate orange appeared to be less susceptible in some tests, but small plants of this species may be killed within two months.

Of 27 lots of grape species, varieties and hybrids planted in a field plot in 1929, survivors of 15 lots were found by Professor H. E. Jacob of the University of California in October, 1945. These were Iona, Molinera, Palomino, Dogridge, Salt Creek, Rupestris St. George, *Vitis arizonica*, *V. flexosa*, Mourvedre × *V. rupestris* (1202), *V. solonis* × Othello (1613), *V. solonis* × *V. riparia* (1616), *V. berlandieri* × *V. riparia* (5-A and 420-A), *V. berlandieri* × *V. rupestris* (99-R) and *V. riparia* × *V. rupestris* (3309). The number of plants lost from these lots, if any, is not known. Dematophora does not seem to have been found thus far in the vineyards of the State.

A dozen species of pears tested in a field plot (6) offered no encouragement for resistance. However, a very few of many seedling replants of *Pyrus communis* in one affected orchard have grown quite well up to fruiting size.

All the plants of nine clonal lots of Marianna and Myrobalan plums grew vigorously in the field plot for about 10 years up to the time the plot was abandoned.

Pittosporum tobira appears to be immune or highly resistant.

Both the Persian walnut, *Juglans regia* (sometimes grown on its own roots), and the native black walnut, *J. hindsii* (commonly used as a rootstock), are susceptible. The butternut, *Juglans cinerea*, and the eastern black walnut, *J. nigra*, have also been killed by the fungus.

Other genera which contain susceptible species are *Berberis*, *Beta*, *Cotoneaster* (6 spp.), *Ligustrum*, *Paeonia*, *Populus*, *Pyracantha*, *Ribes*, *Sorbus* and *Viburnum*.

The following native plants have been killed following inoculation: *Ceanothus megacarpus*, *Holodiscus discolor*, *Juglans hindsii*, *Osmaronia cerasiformis*, *Photinia arbutifolia*, *Pinus ponderosa* var. *Jeffreyi*, *Potentilla glandulosa*, *Prunus ilicifolia*, and *Rhamnus californica*. However, the fungus is not known to have escaped into uncultivated land in California.

Control

Twenty-two chemicals were tested[3] against the fungus in loosely covered metal containers, each holding 30 gallons of soil. Among them were allyl bromide, carbon disulphide, chloropicrin, ethylene dibromide, and formaldehyde. None of the chemicals killed the fungus throughout the soil mass in economically feasible doses.

[3] These tests were made in cooperation with Dr. S. Wilhelm.

Although annual plants have been found susceptible, in general they seem to have escaped serious damage. Lettuce and other truck crops have been grown successfully on land where all of the apple trees have been killed by the fungus.

The plum rootstocks (*Prunus cerasifera* and its hybrids) locally designated as Marianna 2623 and 2624 and Myrobalan C, C-7-1, 3J, 29, Gypsie, Stephens, and Turner all grew vigorously in the infested plot in Santa Cruz County. Among them can be found rootstocks suitable for apricot, plum, and prune.

Separate cultivation of an infested area followed by careful cleaning of implements seems to have been distinctly beneficial in one apple orchard.

It seems hardly necessary in this place to point out the need for great care in the selection and movement of planting stock.

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Phymatotrichum (Ozonium) Root Rot

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Phymatotrichum root rot is a very serious plant disease caused by a soil inhabiting fungus, *Phymatotrichum omnivorum* (Shear) Duggar. It was first reported in Texas about 1888 and since that time has been found in many areas of southwestern United States and in adjoining Mexico. The fungus attacks more than 2,000 species of wild and cultivated plants. The disease sometimes is called Cotton root rot, Texas root rot or Ozonium root rot. Serious economic losses have occurred in certain areas of Arizona, New Mexico, Oklahoma and Texas. Arkansas, California, Louisiana, Nevada and Utah are other states in which the disease has been reported. It is not known to occur in any other part of the world (1, 4, 9).

Plants infected with Phymatotrichum root rot usually die, with the length of time between infection and death depending on the susceptibility of the plant. Cotton plants have been known to wilt and die within 21 days after inoculation (3). The fungus attacks below ground, causing necrotic lesions and destruction of the cortical tissues of the roots.

Occurrence in California

The fungus has been known to occur in California in some areas of Imperial, Riverside, San Diego, and Inyo Counties. It was found by Godfrey in the Bard Valley of Imperial County in 1921[1] and Gilbert reported it on cotton in Southern California that same year (2). It has been found in other areas of Imperial County in subsequent years.[2] In Riverside County it was found in the Palo Verde Valley in 1925,[1] near Indio in 1928 (5) and near Indian Wells in 1930 (6). It was found near Jacumba in San Diego County in 1932 (7, 8) and near Bishop in Inyo County in 1946.[2] The fungus is believed to be indigenous to alkaline soils in southwestern United States, but circumstances indicate that it probably was introduced into some areas in California by movement of infested soil and plant material (5, 6, 9).

Field Diagnosis

The first above ground symptom of Phymatotrichum root rot is a slight yellowing or bronzing of the leaves of infected plants. This is followed by rapid wilting and drying of foliage. In cotton, one of the most highly susceptible hosts, the entire plant is killed and the dead leaves remain attached to the plant. Affected cotton plants occur through a field in spots or areas of irregular outline (Plate I, upper). In crops where plants grow close together, as in alfalfa, more or less circular areas of affected plants occur (Plate I, center). These are characterized by a margin of yellowed and wilted plants marking the periphery and enclosing an area where plants have been killed by the fungus. The root rot patches in the field continue to increase in diameter as the fungus progresses outwardly, and early root infection may be found in the apparently healthy plants within a few feet outside the margin of the spot. In the case of alfalfa there may be some plants remaining alive inside the circle which have not yet succumbed to the disease and are being supported by secondary roots (Plate I, center). Some may be newly established plants. The number of such plants increases after the first year, but these may become infected also.

In some localities, under warm moist conditions which sometimes occur after summer rains or irrigations, the fungus may produce

[1] Records of the U. S. Dept. Agr., Plant Disease Epidemics and Identification Section (formerly The Plant Disease Survey, Office of Mycology and Disease Survey).

[2] Records of the Bureau of Plant Pathology, California Dept. Agr., Sacramento (unpublished).

FIGURE 1. Spore mats at the base of alfalfa plants. The outer zone is pure white and the inner zone becomes a mass of buff colored spores. (Photograph courtesy of R. B. Streets, University of Arizona.)

on the surface of the soil a mycelial structure known as a "spore mat" (Plate I, lower, and Figure 1). The mat usually occurs in shaded or depressed areas in the field. It develops rapidly as a fluffy white fungus growth on which masses of apparently nonfunctional spores develop. It changes to tan or buff color within one or two days. Under conditions of adequate moisture a mat will continue to enlarge, the new growth at the outer margin evidenced by its white color. This structure has been seen rarely if ever in California, probably due to the dry climatic conditions in the areas where the fungus occurs.

Early root infection is characterized by the presence of whitish to tan or buff thread-like mycelium on the root surface. This mycelium later develops into fuzzy brown strands which form a network on the surface of the root (Figure 2). These strands are important in both macroscopic and microscopic identification of the fungus. Necrotic sunken lesions of irregular outline develop on the root surface, enlarge and coalesce. Eventually the root cortex is destroyed and the entire root rots. On cotton there is commonly a reddish color at the junction of necrotic and healthy tissue that can be seen by scraping the root surface with a knife.

In addition to the mycelia, mycelial strands and spore mats, the fungus produces in the soil resting bodies known as sclerotia. These sclerotia are small, one to three millimeters in diameter, of irregular shape, and light colored to black. They may remain viable in moist soil for several years and then produce mycelia which may become the source of new infections. Most sclerotia are found about one to two feet deep, but some have been found as deep as eight feet.

Microscopic Appearance and Identification

Identification of the fungus is accomplished by the microscopic examination of the mycelial strands found on the roots, and is based on the minute, straight side-growths of buff colored to brownish single mycelia or hyphae which arise from the fuzzy strands. These side-growths develop needle-like branches at right angles to a main hyphal branch, and form cross-like structure. Since these "acicular" hyphae are unique for this fungus, their presence is considered as a definite diagnostic character.

Microscopic structures of the fungus are shown in Figure 3. A, B, and C show the mycelia as single hyphae (A) and in multiple hyphal strands (B and C). Acicular hyphae are shown attached to the fuzzy strands at B and C and alone at D. Spores (conidia) and their supporting hyphae (conidiophores) which are produced on the spore mats are shown at E and F. Conidia, sometimes produced laterally on vegetative hyphae, are shown at G. A cross section of sclerotial tissue, the resting stage of the fungus, is shown at H.

Hosts and Carriers of the Fungus

Over 2,000 species of wild and cultivated annual and perennial dicotyledonous plants are hosts of the Phymatotrichum root rot fungus (1, 10, 11). Monocotyledons, such as grasses, sedges and corn are considered immune but can be a means of spread, if the fungus mycelia or sclerotia are either adhering to the roots or are in soil surrounding the roots.

Plants found infected in California include alfalfa (11), carrot,[1] cotton (2, 11) fig,[1] box elder (8, 11), olive,[1] paloverde (*Cercidium*) (11) tamarisk (11), and pistachio (11). Although the fungus has been found on the surface of date palm roots, it is possible that the palm was acting only as a carrier and not as a host (11).

Control

The distribution of sclerotia, at considerable depths in the soil, makes eradication with presently known chemicals economically impractical except in infestations of very limited area.

The most practical means of control include the following: (1) planting of immune or resistant plants; (2) the planting of winter or early maturing crops to avoid high temperatures which are favorable to the fungus; (3) the use of rotations wherein susceptible crops are planted not more frequently than once in four years; (4) and the use of leguminous crops as organic manures.

In California internal and external quarantines are enforced to prevent the movement of rooted plants and soil into or within the State from known infested areas to new locations.

[1] Records of the Bureau of Plant Pathology, California Department of Agriculture (unpublished).

FIGURE 2. Infected cotton root showing root-rot strands, formed by the joining together of several fungus hyphae on the surface of the root. Magnified 4 times. (Photograph courtesy of R. B. Streets, University of Arizona.)

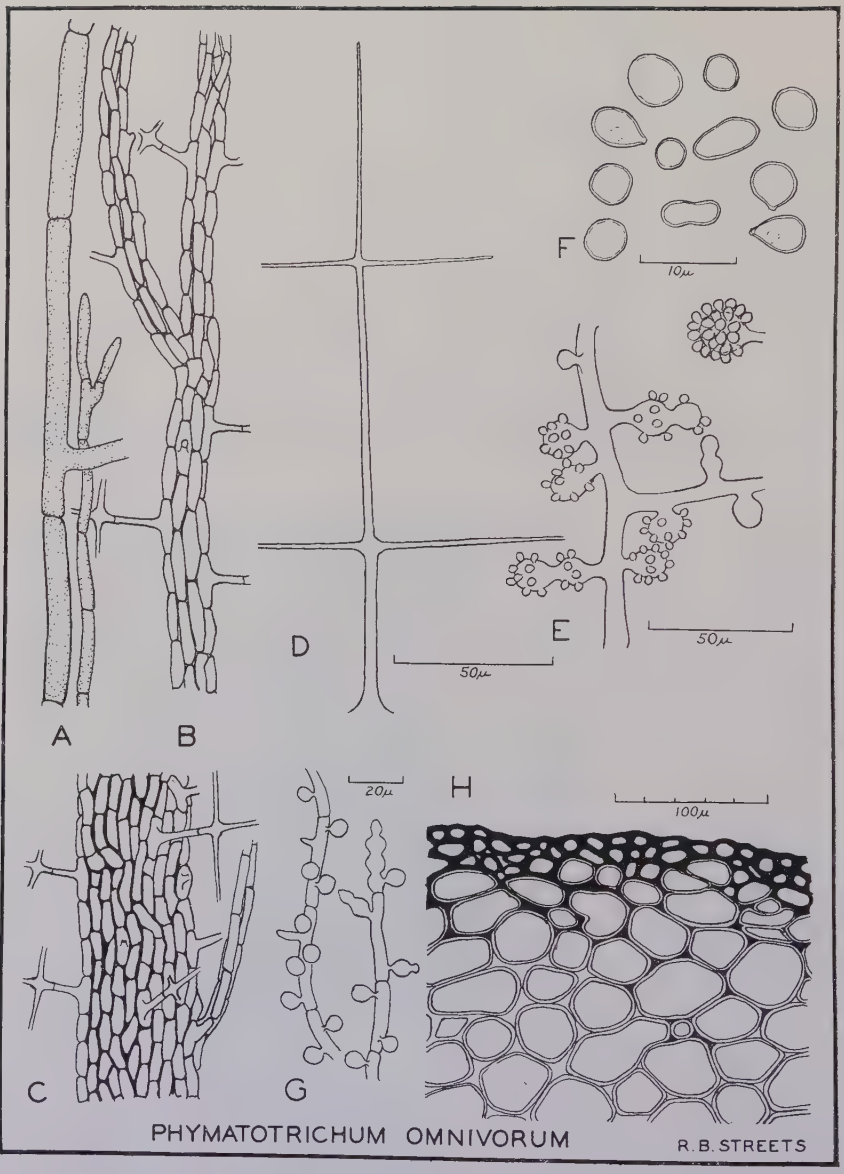

FIGURE 3. Morphology of *Phymatotrichum omnivorum*. A, *Single hypha;* B, young strand formed by the joining together of several hyphae; C, mature strand; D, acicular hypha by which the fungus can be identified; E, conidia and conidiophores from spore mat; F, conidia; G, conidia borne laterally on vegetative hyphae; H, cross section of sclerotial tissues. (Drawings courtesy of R. B. Streets, University of Arizona.)

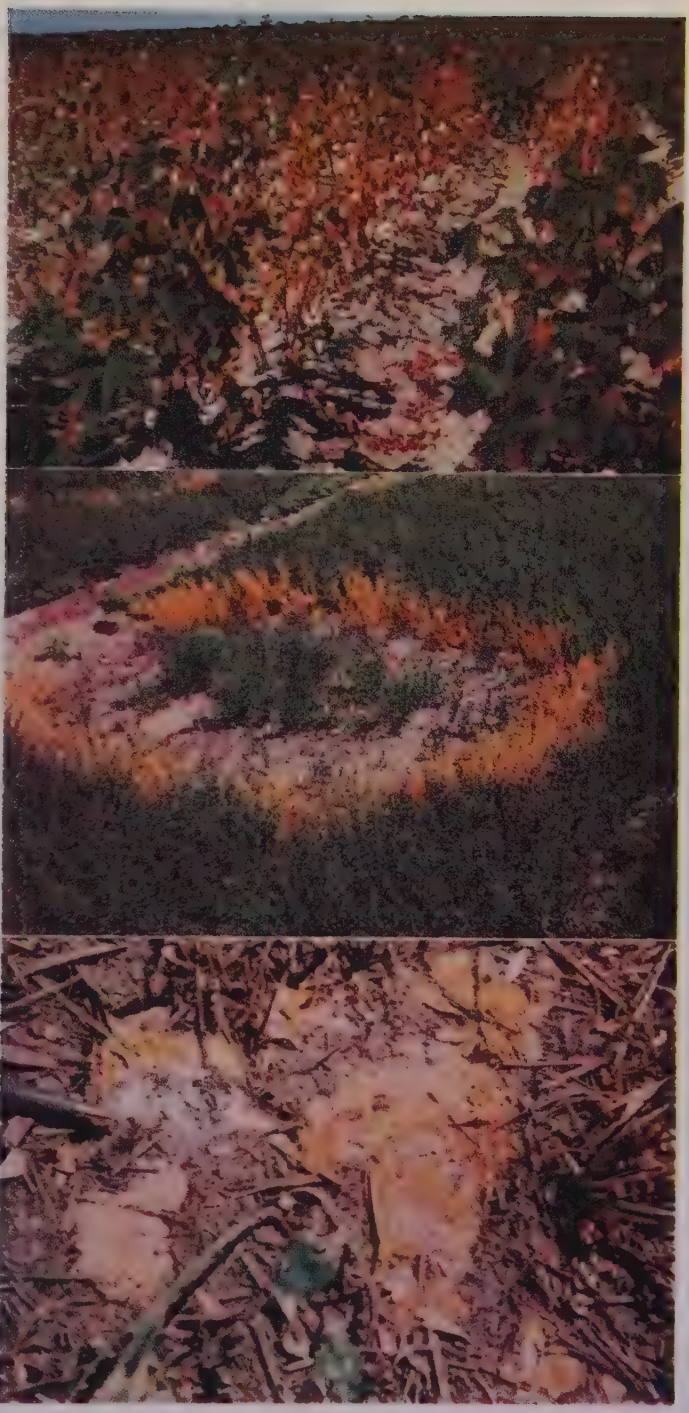

PLATE I. *Upper.* Cotton plants infected with Phymatotrichum root rot. Leaves are adherent to killed plants. The area of infection (brown plants) is irregular in outline, which is typical for row crops.

Center. Alfalfa plants infected with Phymatotrichum root rot. The area of infection is circular, which is typical for crops where plants are seeded close together. Yellowed, wilted and dead plants occur at the outer edge of the large circle. The bare spaces are areas where plants have died. The green plants occurring inside the circle are ones which have not yet succumbed to the disease and are being supported by secondary roots.

Lower. Spore mats of the fungus *Phymatotrichum omnivorum* formed at the base of infected alfalfa plants. The white portion is composed of fungus hyphae, and the buff portion is a powdery mass of spores. These mats are not common in California. (Photographs by Roy M. Nakayama.)

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IN MEMORIAM

DR. CLARENCE EDWARD TAYLOR

Dr. Clarence Edward Taylor, Veterinarian III, Bureau of Livestock Disease Control, California Department of Agriculture, died suddenly the evening of November 28, 1955, in a West Sacramento motel. He was District Veterinarian, San Francisco, and had come to attend a two-day conference of district veterinarians at the Sacramento office.

Dr. Taylor was born January 25, 1912, at Aberdeen, Washington. He graduated from the Washington State Veterinary College in 1934. During succeeding years he was with the United States Bureau of Animal Industry, engaged in tuberculosis and brucellosis control work; private veterinary practice, Sacramento; meat and dairy inspector, San Francisco Department of Public Health; veterinary livestock inspector, California Department of Agriculture; and served five years in World War II, attaining the commission of major in the Veterinary Corps.

Following military service he returned to the Bureau of Livestock Disease Control, as a field veterinarian for one year and later a supervising veterinary livestock inspector, in charge of the San Luis Obispo District office for four years. In January, 1952, he took charge of the San Francisco District. He had held the civil service title of veterinarian III since 1953.

Dr. Taylor was a great credit to the veterinary profession, not only as an energetic and outstanding district veterinarian but also as an active member in local, state and national veterinary associations in which he held many offices. Three weeks before his death he was elected President of the Bay Counties Veterinary Medical Association.

He resided in San Mateo and is survived by his wife Ruby, daughter Melissa, young son Rex, his mother in San Francisco and a brother in Sonoma.

Funeral services were at San Mateo, December 1, 1955, and interment was at Provo, Utah.

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The *Quarterly Bulletin*, published as a contribution to the welfare of California Agriculture, is mailed free to California citizens interested in the work of the Department of Agriculture. The *Bulletin* is exchanged, on request, for publications of the Federal Government, Experiment Stations, and other state or national agricultural offices or organizations.

Entered as second class matter, October 6, 1919, at the U. S. Post Office, Sacramento, California, under the Act of Congress, June 6, 1900.

Address communications to: Editor, the *Quarterly Bulletin*, California Department of Agriculture, 1220 N Street, Sacramento, California.

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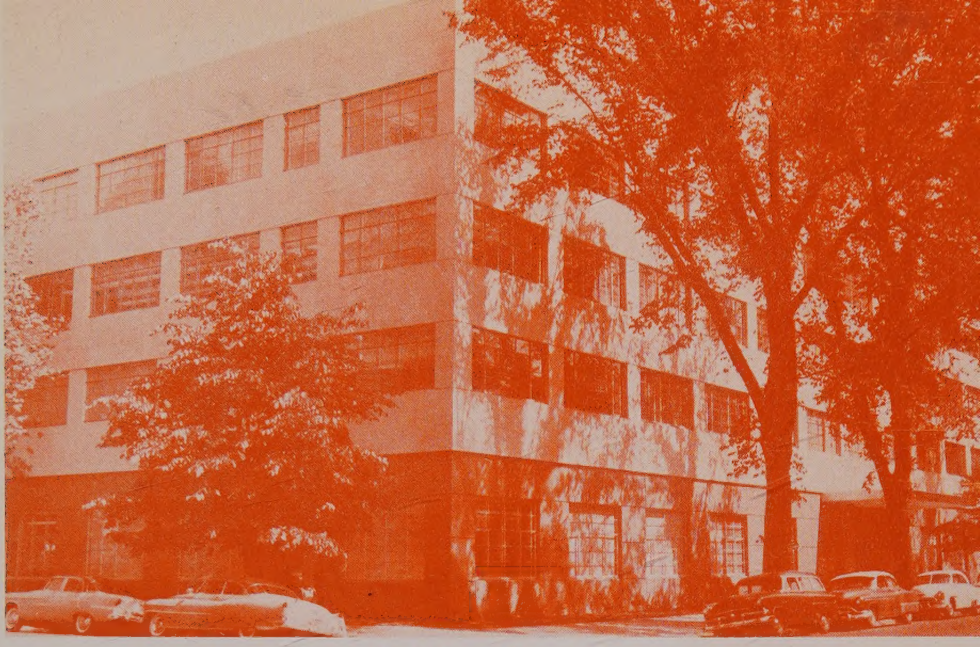
26825 11-55 2M

printed in CALIFORNIA STATE PRINTING OFFICE



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